



# Health Information System

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**HEALTH  
INFORMATION  
SYSTEM**

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*Cerdas, Bahagia, Mulia, Lintas Generasi.*

# HEALTH INFORMATION SYSTEM

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# PREFACE

The term "health information system" (HIS) describes a system created to handle medical or nursing data. This comprises the operational management of a hospital, systems that support healthcare policy choices, and systems that gather, store, maintain, and send an electronic medical record (EMR) for a patient.

Systems that manage data on the operations of healthcare organizations and providers are likewise included in the category of health information systems. When combined, these can be used to enhance patient outcomes, guide research, and have an impact on decision- and policy-making. Security is a top priority since health information systems frequently access, process, or store substantial amounts of sensitive data.

Understanding the Health Information System is very important for nursing students because currently health services without exception have entered the digital era where all nurses must be able to take advantage of advances in digital technology. This book is divided into 4 groups of parts. First, students are invited to differentiate the concept of digital health transformation in Indonesia with Health Management Information Systems and Nursing Management Information Systems. Second, describe Nursing Informatics to facilitate nursing clinical management and decision-making. Third, operate applications to process statistical data and databases and Fourth, produce scientific written work from reputable international journals with a low similarity percentage.

Hopefully, this simple book can add to students' references for understanding Health Information Systems and nursing decision-making by utilizing information technology.

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## LIST OF ABBREVIATIONS

AEFI/KIPI	= Adverse Events Following Immunization/ <i>Kejadian Ikutan Pasca Imunisasi</i>
AHIMA	= American Health Information Management Association
AI	= Artificial Intelligence
AMIA	= American Medical Informatics Association
ANA	= American Nurses Association
ARRA	= American Recovery and Reinvestment Act
ATA	= American Telemedicine Association
BBPK	= Balai Besar Pelatihan Kesehatan/Center for Health Training
BIDW	= Biobank Indonesia Data Warehouse
BPJS Kesehatan	= Badan Penyelenggara Jaminan Sosial Kesehatan/Social Security Administrator for Health
BPOC	= Barcode Point of Care
BRIN	= Badan Riset dan Inovasi Nasional/National Research and Innovation Agency
CAMHS	= Child and Adolescent Mental Health Services
CDS	= Clinical Decision Support
CDSS	= Clinical Decision Support Systems
CIO	= Chief Information Officers
CMC	= Chemistry, Manufacturing and Controls
CMS	= Centers for Medicare and Medicaid Services
CNO	= Chief Nursing Officers
COBIT	= Control Objectives for Information Technologies
COVID-2019	= Corona Virus Disease -2019

CPOE	= Computerized Practitioner Order Entry
DDI	= Drug-Drug Interactions
DDSS	= Diagnostic Decision Support Systems
DHA	= District Health Account
DICOM	= Digital Imaging and Communications in Medicine
DL	= Deep Learning
DTO	= Digital Health Transformation
ECG	= Electrocardiogram
EDDS	= Electronic Drug Dispensing Systems
EDP	= Entry Data Processing
EHR	= Electronic Health Record
EHRIS	= Electronic Healthcare Record systems
EMR	= Electronic Medical Record
ERP	= Enterprise Resource Planning
EUCS	= End-User Computing Satisfaction
Fasyankes	= <i>Fasilitas Pelayanan Kesehatan</i> /Health Service Facilities
FKRTL	= <i>Fasilitas Kesehatan Rujukan Tingkat Lanjutan</i> /Advanced Referral Health Facility
FKTP	= <i>Fasilitas Kesehatan Tingkat Pertama</i> /First Level Health Facility
GDPR	= General Data Protection Regulation - Europe
GFI	= Goodness of Fit Index
GISAID	= Global Initiative on Sharing All Influenza Data
HHR	= Health Human Resources
HI	= Health informatics
HIE	= Health information exchange
HIM	= Health information management
HIMSS	= Healthcare Information and Management Systems Society
HIPAA	= Health Insurance Portability and Accountability Act - USA,
HIS	= Hospital Information System
HIT	= Health Information Technology



HL7 FHIR	= Health Level 7 - Fast Health Interoperability Resources
HMIS	= Health management information system
HMN	= Health Metric Network
Hospital MIS	= Hospital Management Information System
HOT	= Human-Organization-Technology
HPBs	= Health-Promoting Behaviors
HRO	= High-Reliability Organizing
HRSA	= Health Resources and Services Administration
HTIS	= Health Technology Information System
ICD-10	= 10 <sup>th</sup> revision of the International Statistical Classification of Diseases and Related Health Problems
ICT	= Information and Communication Technology
ICU	= Intensive Care Unit
IDDEAS	= Individualized Digital DEcision Assist System
IHR	= International Health Regulations
IHS	= Indonesia Health Services
IOM	= Institute of Medicine
IoT	= Internet of Things
IS/IT	= Information System/Information Technology
ISO	= International Organization for Standardization
ISSM	= Information Systems Success Model
LOINC	= Logical Observation Identifiers Name and Codes
MIABIS	= Minimum Information About Biobank Data Sharing
ML	= Machine Learning
MTS	= Mobile Telenursing System
NAM	= National Academy of Medicine
NHA	= National Health Account
NI	= Nursing Informatics
NPV	= Negative Predictive Value
OpenAPI	= Application Programming Interface
PaaS	= Platform-as-a-Service

PACS	= picture archiving and communication system
PCR	= Polymerase Chain Reaction
PEOU	= Perceived Ease of Use
Permenkes	= <i>Peraturan Menteri Kesehatan</i> /Regulation of Minister of Health
PHA	= Provincial Health Account
PHR	= Personal Health Record
PIPEDA	= Personal Information Protection and Electronic Documents Act - Canada
Poltekkes	= Politeknik Kesehatan/Health Polytechnic
PPE	= Personal Protective Equipment
PPV	= Positive Predictive Value
PU	= Perceived Usefulness
Pusdatin	= Pusat Data dan Informasi/Data and Information Centre
Puskesmas	= Pusat Kesehatan Masyarakat/Public Health Center
Puskesmas MIS	= Puskesmas Management Information System
QI	= Quality Improvement
REST API	= RESTful Application Program Interface
RFID	= Radio-Frequency Identification
Risnakes	= <i>Riset Tenaga Kesehatan</i> /Health Manpower Research
Rx	= prescription
SARS-CoV-2	= Severe Acute Respiratory Syndrome Coronavirus 2
SHA	= System Health Account
SIP	= <i>Surat Izin Praktik</i> /Practice Permits
SNOMED CT	= Systematized Nomenclature of Medicine Clinical Terms
SOC	= Security Operation Centre
STR	= <i>Surat Tanda Registrasi</i> /Registration Certificates
TAM	= Technology Acceptance Model

TIGER	= Technology Informatics Guiding Education Reform
TPB	= Theories of Planned Behavior
TRA	= Theories of Reasonable Action
TTAS	= Telephone Triage and Advising Services
TTF	= Task Technology Fit
U.K.	= United Kingdom
UHC	= Universal Health Coverage
UIS	= User Information Satisfaction
UKM	= <i>Upaya Kesehatan Masyarakat</i> /Community Health Efforts
UKP	= <i>Upaya Kesehatan Perseorangan</i> /Individual Health Efforts
UTAUT	= Unified Theory of Acceptance and Use of Technology
VTTO	= Vendor Tool Try-Out
WHO	= World Health Organization

# **COURSE OVERVIEW**

This course is designed to provide you with the knowledge and skills necessary to integrate nursing science with various information management and analytical sciences in order to identify, define, organize, and share data, information, knowledge, and wisdom in nursing practice. Nursing Informatics supports nurses, consumers, patients, the interprofessional health-care team, and other stakeholders in all positions and situations in order to achieve the desired outcomes. This support is provided using information architecture, information procedures, and information technologies.

The material in this book is important to you if you work in the clinic or community nursing services. This material provides benefits related to your understanding of nursing informatics. In the United States, nursing informatics has become one of the specialties in nursing. The learning activities presented in each unit in each module can provide an understanding of nursing informatics and its implementation in nursing services.

Students are expected to understand the topic. After successful completion of this course, you will be able to:

1. Understand Health Digital Transformation in Indonesia
2. Understand Health Management Information System
3. Understand Nursing Informatics
4. Understand Clinical Decision Support Systems in Nursing
5. Understand Health Information System Evaluation
6. Understand Telehealth and Telenursing
7. Operate SPSS for Nursing Students
8. Operate Microsoft Excel for Beginners
9. Operate Manager References: Zotero

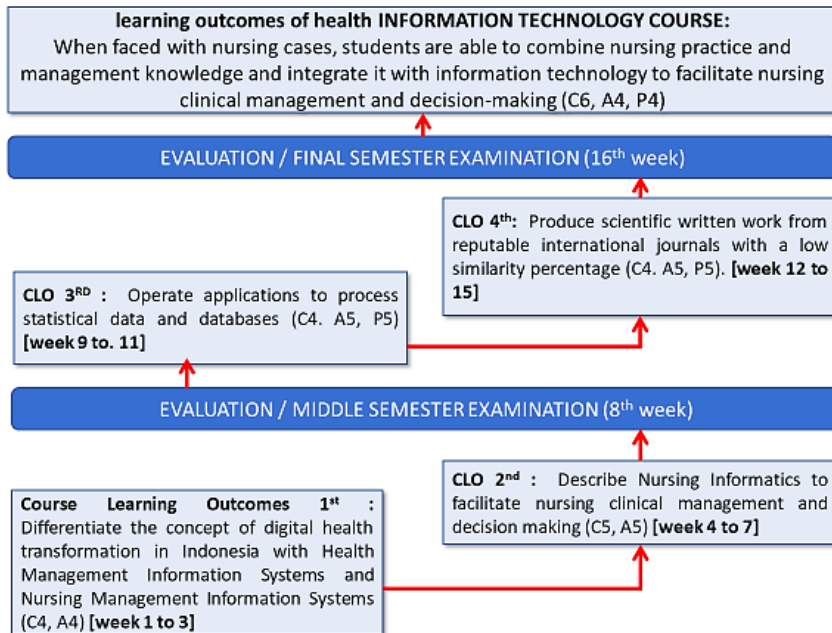
10. Operate Quillbot: An Artificial Intelligence Paraphrasing Tool Online
11. Operate Turnitin: Plagiarism Checker

The following details must be taken into consideration to obtain these competencies:

1. You must take your studies seriously and try to apply what you learn to the settings in which you perform clinical nursing.
2. Work as hard as possible on the exercise assignments after each learning activity to thoroughly comprehend the subject matter.
2. A summary of key information is provided after each learning activity to help you better understand the important ideas in this module.
3. Once you have a firm grasp of the material in this module, concentrate on the formative exam questions that can be used to enhance learning and repair modules. The outcomes of formative tests can also be used to gauge how well you understand or perform on a subject.

***Break a leg, and good luck.***

## LEARNING OUTCOMES OF HEALTH TECHNOLOGY COURSE





# UNIT I

## HEALTH DIGITAL TRANSFORMATION IN INDONESIA

### **Learning Objectives :**

After taking this chapter, you'll be able to:

1. Identify the health service problems
2. Explain the health technology transformation
3. Explain the health technology enterprise architecture

### **A. Introduction**

As the digital era has evolved, routine and high-quality data integration has become crucial to achieving digital transformation. To reach Healthy Indonesia, features like integrated data and a simpler health service system must be continually enhanced.

There are numerous difficulties in the simpler procedure of integrating health service data. The development of several health applications by the federal, state, local, and private sectors has made it difficult to integrate health data systems. Applications that are meant to make life easier and have the potential to improve health care actually cause more issues by spreading data across multiple applications already in use and having inconsistent standards that prevent easy integration and use. When a large amount of health data is discovered that is still manually documented, this presents another issue with health digitalization. In many locations, health data are still recorded on paper and not digitally integrated.

More than 80% of Indonesia's health service facilities are not currently connected to digital technology, and data is fragmented

and dispersed across hundreds of different health sector applications due to regulatory restrictions on standardization and data exchange (Kurniawan & Novi Sulistia Wati, 2021).

## **B. Health Service Problems**

### **1. Primary and Secondary Services**

Primary services consist of health centers, clinics, and general practitioners, and secondary services consist of all hospitals, both general and specialized hospitals. Primary and secondary services are the spearhead of health services serving around 272 million people throughout Indonesia.

The use of information technology in the health sector has been used quite widely, from health planning to providing various health data both at the individual and community levels (Regulation of the Minister of Health of the Republic of Indonesia No. 21 of 2020 concerning the Strategic Plan of the Ministry of Health for 2020-2024). However, with the various functions of existing applications, fragmentation of the health information system occurs and the existing data cannot be exchanged.

In carrying out health services, the World Health Organization (WHO) states the importance of prioritizing the principle of the continuum of care in health services where health facilities monitor patient health on an ongoing basis (Seidu et al., 2022). Continuous and comprehensive patient observation can assist health workers in evaluating the health management given. The results of a good management evaluation can facilitate communication between Health Facilities to carry out referrals effectively and efficiently if needed.

Incomplete, inconsistent, and low-accuracy data recording is a major factor in the decline in the quality of services in healthcare facilities. Complete and standardized data recording can facilitate the preparation of evidence-based policies, and the preparation of healthcare facilities to increase competency and reduce the administrative workload of primary health care and hospitals, which



until now use more than 60 applications at once to fulfill reporting administration.

From the explanation above, it can be concluded that some of the main problem focus points in primary and secondary services are as follows:

- 1) It is difficult for health workers to access health data easily, continuously, and in real-time
- 2) The completeness, consistency, and accuracy of health data have not yet been achieved in meeting the needs of evidence-based policymaking
- 3) There is no standardization and integration of Health data making it difficult to realize Health data interoperability in implementing the continuum of care principle
- 4) Recording of Health data is not effective and efficient because the number of administrative applications is too much so the recorded data overlaps.

## **2. Pharmacy and Medical Equipment Services**

The goal of the Pharmacy and Medical Equipment Program is to increase access, self-reliance, and quality of pharmaceutical and medical equipment, with the following key performance indicators (Decree of the Minister of Health No. HK.01.07/Menkes/422/2017 concerning the Strategic Plan of the Ministry of Health 2015-2019):

- 1) The percentage of districts/municipalities with access to essential medications is 85%;
- 2) The percentage of medical devices that meet standards is 95%;
- 3) The percentage of Puskesmas with access to the IDL vaccine (Complete Basic Immunization) is 96.5%;
- 4) The percentage of domestically produced pharmaceutical preparations is 100%;
- 5) The percentage of domestically produced medical devices is 100%.

In addition, during the Covid-19 outbreak in Indonesia, the durability of the medical equipment and pharmaceutical supply were put to the test. The healthcare industry's supply chain is in the news. The healthcare system is significantly impacted by the virus's spread. Healthcare facilities are operating under never-before-seen operational restrictions as demand rises. The manufacture and distribution of medical supplies presents the biggest difficulty in controlling this crisis. It becomes difficult to obtain and distribute personal protective equipment (PPE), ventilators, and medications when these items are required. Due to shortages, the healthcare supply chain has been made vulnerable (Iyengar et al., 2020). Lack of integration in the healthcare supply chain has made it difficult for medical facilities to react swiftly to the risk that is currently there. This highlights the significance of creating a reliable and flexible service supply chain.

The following are more explicitly the major problems facing the pharmaceutical and medical equipment industries:

- 1) There is no standardization of business practices, goods, or raw materials. Due to the lack of a single important data feature for data aggregation and processing, this is the primary problem impeding the development of an integrated platform.
- 2) There is no standardized data format and each manufacturer, distributor, and medical facility stores its own stock data for medications, medical equipment, and home healthcare products.
- 3) Poor supply and demand mapping results in high stock-out opportunity costs, the spread of dangerous medications and vaccines, and poor public health.
- 4) Duplicate licensing procedures and compliance monitoring, which mandate that businesses in the pharmaceutical and medical equipment sectors register with and submit reports to numerous bodies on the same chemical.

### **3. Health Security Services**

The quality of an emergency response is highly dependent on the effectiveness of resource allocation in critical sectors and a coordinated response across sectors in the shortest amount of time (Alam et al., 2022). Health security plays a very important role in a country. Global public health security is defined as the ability of a nation to protect its population from the threat of infectious diseases and other health threats, including pandemics, epidemics, and other threats (Moolenaar et al., 2020). Making decisions based on reliable and current data is necessary for developing a responsive and effective health security system (Kruk et al., 2018). The Ministry of Health has been given the following instructions in accordance with Presidential Instruction No. 4 of 2019 concerning Capacity Building in Preventing, Detecting, and Responding to Disease Outbreaks, Global Pandemics, and Nuclear, Biological, and Chemical Emergencies:

- 1) Develop skills for preventing, spotting, and handling pandemics, as well as nuclear, biological, and chemical catastrophes;
- 2) Enhance multi-sectoral technical coordination of the International Health Regulations (IHR) 2005 implementation;
- 3) Strengthen health surveillance capabilities to spot situations that could result in public health emergencies, such as those at the nation's entry and exit points, antibiotic resistance, and food security;
- 4) Increase the prevention and management of zoonoses and antibiotic resistance;
- 5) Increase the quality and coverage of the immunization program;
- 6) Expand capabilities and fortify laboratory networks to pinpoint problems with public health.

According to the US National Health Security Strategy from 2021, health security is a shared duty of state and local governments, public and corporate partners, non-governmental organizations, academic institutions, professional associations,

communities, volunteers, families, and people (US National Health Security Strategy, 2021).

#### **4. Health Human Resource Services**

One of the key factors influencing national health security and the health system generally is a well-mapped human resource for health care. The performance of national health security is based on the accessibility of human resources for health.

Additionally, there is a severe lack of complete Health Human Resources (HHR) data and high-quality information about HHR. HHR planning is one of the strategic concerns outlined at the national level in Presidential Regulation No. 72 of 2012 on the 2012 National Health System. The HHR information system is insufficient, and the implementation is still regarded as being weak.

Additionally, in order to define the needs at each level of government in terms of number, kind, quality, qualifications, and distribution, HHR planning is required, as per Regulation of Minister of Health (Permenkes) No. 33 of 2015. But according to the Health Manpower Research (Risnakes) findings, only 79.8% of Puskesmas and 83.2% of hospitals execute HHR planning in their facilities (fasyankes).

The following are the primary problems in achieving national HHR resilience:

- 1) The only method of data collection and analysis, which results in low accuracy, is the comparison of data from diverse sources.
- 2) Inconsistent data collection practices can result in inaccurate or redundant recording.
- 3) Double or incorrect recording of data can result from non-standardized data collecting.
- 4) The data on the health human resource (HHR) reserves' level of readiness is not standardized and it is missing details on their competence and potential.

## **5. Health Financing Services**

As an enabler for all health services, health funding is one of the foundations supporting the execution of the national health system. Providing knowledge and expertise to enhance the state of the nation's health requires a number of critical components, including transaction records, guarantee programs, and strategic analysis. The stakeholders in health funding require an integrated operational system and high-quality data in order to have a complete knowledge (Kruk et al., 2018).

Decisions, strategies, and strategic suggestions for implementing national health care are based on data and information analysis of numerous transactions. In order to address the national health challenges, the national health expenditures play a significant role. Nominal national health spending in the European Union increases life expectancy and lowers the birth mortality rate by 0.64% for every 1% increase (Onofrei et al., 2021). Individual mortality is positively impacted by health spending across all of China's provinces (Hou et al., 2020). The key determinants of this beneficial effect are strategic analysis and sensible health spending plans.

Based on Law No. 39 of 2009 concerning Health, health financing aims to create sufficient, sustainable, fair, effective, efficient, and comprehensive financing, ensure equity, transparency and accountability with the main functions of mobilizing financing sources, allocating the national health budget, and utilizing the health budget (Law of the Republic of Indonesia No. 36 of 2009). These are performed related to the implementation of Individual Health Efforts (UKP), Community Health Efforts (UKM), and the governance of these efforts. The World Health Organization (WHO) itself establishes System Health Account (SHA) to support these functions by focusing on consumption, provision, and finance (WHO & Organization for Economic Cooperation and Development, 2011).

Self-financing (Out of Pocket) by the community is the main indicator in assessing the performance of the national health spending. This means that all national health expenditures and

spendings are also aimed at reducing self-financing by the community. The national health insurance scheme will have a direct impact on this.

Data and analysis of the national health spending are the basis for providing a strategic direction and to execute spending. The expected objective is to perform all analysis based on standardized data which are adequate both in terms of quantity and quality. The National, Provincial, and District Health Accounts (NHA, PHA, and DHA) as part of the SHA serve as a basis for decision making on the national health spending.

Three main issues related to data input, analysis, and standardization are as follows:

- 1) National health expenditure data are not detailed and do not accommodate all the needs of the national health expenditure analysis.
- 2) The analysis of NHA, PHA, and DHA is only available after two fiscal years and after the national health budget had been executed.
- 3) The national health insurance expenditure data of the government, national institutions, and private entities are not available in a complete and comprehensive form, causing inoptimal performance analysis.

## **6. Internal Management Services**

The effectiveness of each task and required reporting can be increased with the correct internal management system. In this manual, we'll examine the internal operations of the Ministry of Health, as well as those of other organizations that report directly to it, including the Health Polytechnics, Health Training Centers, National Hospitals, and Lab Centers, as well as those that don't, like the Provincial Health Office and the District Health Office, which report to the provincial and sub-national governments.

The creation of this internal management system has a number of goals, including the unification of all currently utilized

apps into a single entity to enable their efficient and effective use as well as the facilitation of data entry to eliminate redundant data.

This system will streamline five key corporate processes, including internal operations, tenders, planning and budgeting, implementation, and monitoring and evaluation, with the help of its 19 primary internal management modules.

## **7. Biotechnology Services**

Indonesian health data are still dispersed, low in number and quality, and subject to sectoral bias, making it difficult to use them to their full potential. Preclinical, clinical, genomic, and other data are included in this discussion. Genomic information includes the human, microbial, animal, and plant genomes. These data are still unable to be gathered, which impedes scientific advancements as well as disease and mutation mitigation. Without a data center that may act as the foundation for innovation based on biotechnology, each sector continues to operate independently (Hillson et al., 2019).

Indonesia's genomic surveillance capability to find novel SARS-CoV-2 mutations is viewed as being woefully insufficient. In terms of the total number of genomes registered in the GISAID database, Indonesia is in just seventh place overall among the ten Southeast Asian nations. Only one unique laboratory can perform genomic surveillance, which is time-consuming and expensive. The impact of this illness on Indonesia's health security is severe (Cahyani et al., 2022).

Although Indonesia has long been developing its biotechnology industry, progress has been uneven and modest in general. The absence of funding for biotechnology-related research is the first factor. Research in biotechnology is required to improve product quantity and quality as well as general biotechnology understanding. Lack of personnel, infrastructure, and government regulations that impede the sale of genetically altered products are other factors (Sayers et al., 2021).

Agriculture, health, and the environment all benefit from biotechnology. Biotechnology aids in the agricultural sector's efforts to enhance agricultural production, improve food quality, and lessen food emergencies. Biotechnology is a tool used to detect and cure various diseases, both genetic and non-genetic. Through bioremediation, bioleaching, the production of bioplastics to reduce plastic waste, and the creation of ecologically acceptable biofertilizers, biotechnology can enhance the quality of a polluted environment.

The Ministry of Health can track registered businesses, researchers, and the volume of transactions thanks to the design of the biotechnology platform. To keep customers engaged after the launch of this platform, extensive communication is required. To address the needs, the required ecosystem will be created by public education.

## **C. Health Technology Transformation**

### **1. Health Technology Transformation Priority**

A health governance reform that incorporates the integration of information systems, research, and development is required under Regulation of the Minister of Health of the Republic of Indonesia (Permenkes RI) No. 21 of 2020. It is undoubtedly difficult and requires careful planning for the digital health transformation process to move from the national to sub-national level. The roadmap for the transformation of health technology includes this.

Figure 1.1 illustrates the three key actions that make up the Health Technology Transformation Roadmap. Health Data Integration and Development is the first phase of the Health Technology Transformation. It is separated into the development of a health big data analytics system and the integration of health data systems. The primary outcome of this effort is to enhance the standard of health policies based on precise, current, and comprehensive data.

The integration and development of health service applications makes up the second section. Developing Integrated



Health Applications, enhancing Health Human Resource (HHR) with health informatics skills, and establishing a centralized helpdesk at the Ministry of Health are the three program actions included in this activity. The effectiveness of health services across all lines (First Level Health Facility/FKTP and Advanced Referral Health Facility/FKRTL) is reflected in this output.

The development of the health technology ecosystem is the third section. The Ministry of Health's three key initiatives in this area are the development of health technology innovation product ecosystems, the expansion of telemedicine technology, and the integration of health biotechnology research. Its goal is to foster partnerships and an innovation ecosystem for digital health among businesses, colleges, government agencies, and the general public.

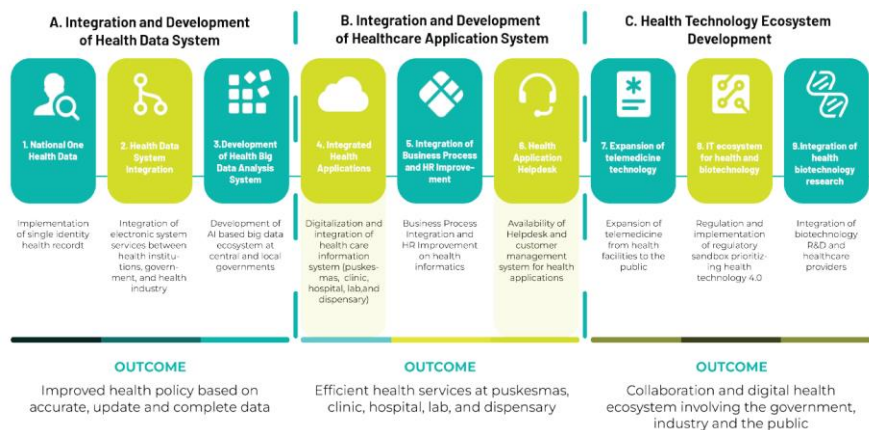


Figure 1.1. Priority Activity of Health Technology Transformation

Integrating and developing health data consists of three program actions. National Health Data System is the first. An implementation of the Integrated Electronic Medical and Health Record, also known as the National Individual-Based Health System, is this program. The second is the integration of health data systems, which consists of integrating electronic system services between health authorities within the federal government, local governments, and the health industry. Development of Big

Data Analysis Systems for the Health Sector is the third program. With artificial intelligence analysis at both the central and local levels, the program will create a big data ecosystem for health. Improved health policy based on accurate, current, and comprehensive data is the primary product of this activity.

An unintegrated health data system has been linked to a number of problems, including underreporting and incompleteness. The collected data's quality will be impacted by this. Public health will suffer as a result of health decisions that are not supported by reliable evidence.

In 2021, initiatives outlined in the strategy for the transformation of health technology will start to be implemented. An integrated electronic health record will have its architecture built this year. The creation of a big data system built on an integrated Electronic Health Record (EHR) will continue in 2022. In 2023, a system for analyzing large amounts of health data will then be put into place. It will still be going in 2024, and coverage should increase. For the quality of health policies based on data analysis to improve, health data integration and development are required. Starting with the health department and national institutions (such BPJS Kesehatan), moving up to health providers and facilities, and finally the health sector, this program will focus on stakeholder components.

## **2. Health Application Integration and Development**

The Health Technology Information System (HTIS) continues to develop, so the development of health applications is also needed to optimize health services and management at various levels of health services. The targets of these activities are Puskesmas, clinics, health centers, hospitals, laboratories, pharmacies, and the health office. The expected output is the optimization of health services and management at the level of Puskesmas, clinics, hospitals, laboratories, and pharmacies with the support of efficient and integrated applications.

The integration of health applications will focus on the integration and digitization of health emergency response services, primary services, pharmacy services, referral health services, health financing, health human resource management, covid-19 vaccination, internal management of the Ministry of Health, and Ministry of Health infrastructure. These highly varied services require a platform that includes all nine health services.

### **3. Health Technology Ecosystem Strengthening**

Developers of digital health technology are becoming more prevalent year over year. As Electronic System and Transaction Operators, the majority of these developers have formally registered with the Ministry of Communications and Information Technology. But as of right present, none of the companies creating digital health technologies are managed by the Ministry of Health. The Cooperation Agreement is the sole legal foundation the developers have thus far. In order to create legislation that can keep up with the rapid advancement of digital technology in the health sector, a new strategy is therefore required.

#### **a. Telemedicine Technology Expansion**

Health technology is developing more slowly in the health sector than it is in other industries like e-commerce and banking, but it is progressively gaining momentum in Indonesia. Telemedicine technology, which has been extensively developed by private inventors in the form of digital startup enterprises, is one of the technologies that has been quickly accepted. Telemedicine is now used much more frequently as a result of the Covid-19 epidemic. In order to reach Universal Health Coverage (UHC) for at least 95% of the population, or as many as 257.5 million people, by 2020, the use of telemedicine is tied to this goal. Additionally, this telemedicine technology addresses the problem of the public's limited access to healthcare services due to the lack of human and infrastructure resources in the field of health care.

b. Innovative Health Technology Product Ecosystem Development

The government is responsible for identifying opportunities or developing new regulations to encourage the public to participate in creating or even supporting each of these innovations, as well as for implementing the regulatory sandbox and developing the ecosystem for innovative health technology products as well as for incubating Health Technology 4.0. The regulatory sandbox is crucial because it can be used for a variety of purposes, such as: (1) testing a regulation based on real circumstances that occur more quickly and accurately; (2) bridging the needs between developers in the digital health industry and health regulators; and (3) offering assurances to investors who want to invest in start-up companies in the health sector.

c. Health Biotechnology Research Integration

The government is responsible for identifying opportunities or developing new regulations to encourage the public to participate in creating or even supporting each of these innovations, as well as for implementing the regulatory sandbox and incubating Health Technology 4.0. The regulatory sandbox is crucial because it can serve a variety of purposes, such as: (1) testing a regulation based on actual circumstances that occur more quickly and accurately; (2) bridging the needs between developers and health regulators in the digital health industry; and (3) offering assurances to investors who want to invest in start-up businesses in the health sector.

#### **4. Digital Transformation Governance**

The national digital health vision is effectively designed thanks to effective leadership and governance, which also increases transparency and confidence. Processes must be carried out with proper stakeholder consultation and in a structured, timely way to achieve effective management. By creating a Digital Transformation

Management Team, which is made up of an Operations Team, a Technology Team, a Product Development Team, and a Data Management Team, the organizational structure of the Health Technology Transformation management is built. Eight Sub-Working Groups (Tribes) are also present, including the Primary Care Tribe, Secondary Care Tribe, Pharmacy Resilience Tribe, Health Resilience Tribe, Health Financing Tribe, Health HR Tribe, Internal Management Tribe, and Biotechnology Tribe.

**a. Role of the Digital Transformation Office in Realizing Digital Transformation**

The Ministry of Health's Special Team for Digital Health Transformation (DTO) is in charge of planning and managing the process of developing a national digital health vision, gathering data, analyzing it, and compiling it. It also conducts research and consults with stakeholders. Finally, it coordinates and centralizes the development of information technology related to the digital transformation.

DTO also carries out a complete integration of the digital transformation process inside the government. Technical integration, human resource integration, and policy governance integration are all examples of integration that has been done. This connection leads to a quick and flexible digital transformation, especially when it comes to meeting the primary needs of the health sector during the pandemic. The DTO of the Ministry of Health has won numerous awards, both formally and informally (good public opinion on social media).

**b. Role of Work Units in Digital Transformation**

For the purpose of implementing digital transformation, DTO, Pusdatin, and work units cooperate. Planned, directed, and substantive product and service research is provided by the relevant Work Units. The key to the success of this procedure is collaboration between the work units with Pusdatin and DTO. Following that, application development will be handled centrally by the Pusdatin and DTO teams. The appropriate

work units next apply DTO and Pusdatin in a trial manner. While still evaluating the application, the work units will also implement it in the field. By observing and assessing the implementation, DTO and Pusdatin will provide assistance.

#### **D. Health Technology Enterprise Architecture**

##### **1. Urgency of the Platform Approach and Enterprise Architecture**

The Ministry of Health fully assuming the position of developer and providing support for national implementation under the in-house development strategy is not a practical option as it demands a lot of human resources. While this is going on, numerous platforms and data formats are used by the various stakeholders in the health business, including health technology companies, hospital operators, clinics, and pharmacies. The national health data are consequently dispersed among the service providers.

The Ministry of Health must implement a platform-based strategy (also known as PaaS, or "Platform-as-a-Service") to bring about technological transformation and digitization in order to close the digital divide. To establish trustworthy national health data, the Ministry of Health must create a platform that links the full ecosystem of players in the health business. The platform will connect several application platforms; it won't replace or combine all of the functionality of existing applications.

The platform offers defined guidelines and methods for security, technical elements, business operations, and data. Applications using the platform must adhere to requirements for business processes, data sharing protocols (based on HL7 FHIR and HTTPS REST API), and security (authentication, and encryption) requirements. Due to its independence from particular programming platforms, this platform will enable national health data collaboration with all stakeholders in the health business.

The enterprise architectural platform blueprint contains specifications for business process, data, and application standards. It acts as the cornerstone for coordinating all

stakeholders' application platforms in the health industry so that they can be brought together into a unified platform.

## **2. Platform Development Principles**

The principles of the national health data platform development are as follows:

### **a. Service-Based Platform**

The delivery of healthcare services at healthcare facilities and other auxiliary facilities must serve as the foundation for the national health data. Along with the provision of healthcare services, data will be generated. Periodic reporting that is aggregated, which tends to increase the administrative load and doesn't provide enough data depth for additional analysis, is not how the data is created.

### **b. Architecture Standardization and Specifications**

The "standardization of specifications, not standardization of applications" philosophy is adhered to by the platform-based approach. It doesn't create a single app that is applied consistently across Indonesia. Instead, it creates architecture standards and specifications that can be utilized by different health industry players. A technical guide, the standard enables data transmission between many platforms.

### **c. Collaborative Healthcare Ecosystem**

The platform-based strategy is built on the idea of working with the full ecosystem of health industry participants to provide health services across Indonesia. This platform will therefore be used by all stakeholders in the health business, rather than replacing current systems or applications.

### **d. Open API Based on Microservices**

The platform will be built through an Open API based on microservices in order to fulfill the spirit of collaboration amongst actors in the health business as stated in the third principle above. Technically speaking, an open API is a reusable services idea where the platform offers data interchange services that service providers can employ.

Players in the health sector are free to use all of their imagination when creating new health care technology, although part of its functionality may benefit from platform-provided data interchange services. The availability of this service benefits industry players by accelerating time to market and delivering better services.

**e. Compliance through Integration**

The platform-based strategy gives the Ministry of Health the ability to oversee, track, and assess the performance of many stakeholders in the health sector. The Ministry of Health can monitor adherence to data requirements and fulfillment of service standards through transaction activities that flow on the platform by joining the players in the health business.

**f. Mutual Benefits through Ease of Service and Integrated Information**

The platform is helpful to everyone involved, but all actors in the health industry must sign up. In addition to requiring the integration of corporate processes, the platform also offers advantages in the form of integrated data and processed data, such as analytics, forecasts, and other types of data.

**3. Platform Indonesia Health Services**

The Citizen Health App, an application that contains complete personal health data (Personal Health Record), allows the general public to access health information. "Partner Systems" stands for additional user groups and refers to platforms or applications now employed by the healthcare sector, including Hospital MIS, Puskesmas MIS, Laboratory apps, and others.

The IHS (Indonesia Health Services) Platform, the brains of the health technology platform, is where the Citizen Health App and Partner Systems are both interconnected. The Ministry of Health's HIS platform is part of an ecosystem for digital health. IHS was created to make it simpler for companies in the health business to link with a single health data system and guarantee that all medical transactions may be correctly documented and used. The general



public also gains from it in addition to the industrial actors. Through the Citizen Health App, they can review their own or their family' health transactions to obtain health education materials selected by reputable sources.

The Ministry of Health oversees the creation and management of the IHS Platform and Citizen Health App, which can also be linked to Partner Systems or already-existing applications run by other parties.

Three main problems are addressed by the Citizen Health App platform. The lack of integration and poor interoperability of personal health data is the first issue. When using numerous medical services, this results in redundancy for the healthcare system. The inability of the general populace to keep track of their own medical history is the second issue. This is due to the fact that medical records are dispersed throughout different health services. Last but not least, the health care that people currently receive do not follow an individual strategy. For instance, health education is frequently given to the wrong people and is not given personally.

#### **4. Platform Architecture Design**

##### **a. Business Architecture**

Business architecture is one component of enterprise architecture that can efficiently and effectively map from a business and technological perspective. For the development of business architecture, there are numerous techniques. The first step is to map all the applications used by the Ministry of Health and organize them according to the services and functions that each provide. The goal of this exercise is to find existing applications that overlap or perform the same service purpose. This platform's objective is to develop an innovation, a simplification, or a synthesis of multiple functions.

An in-depth interview is the second method. Invited subject-matter experts are used to carry out this strategy. With this approach, each service's problems are reformulated in new ways. Potential efficiencies based on these problems will

be developed, one of which is the streamlining of fundamental services. Additionally, by using this technique, experts on the current services are encouraged to expect a breakthrough or new innovation.

The legal strategy is the final technique. Based on the applicable laws and rules set forth by the Minister of Health, the business architecture was developed. One illustration is the Health Minister's Regulation No. 4 of 2019 about Technical Standards for Fulfilling Minimum Service Standards and Basic Service Quality in the Health Sector. The provision of services for expectant mothers, the elderly, and children under the age of five is supported by the rule governing the primary care process. It serves as the foundation for developing the full business cycle for maternity care. The rule serves as a guide for creating business processes for each service as a result.

All services are built on the foundation of these techniques. Each business process from each department or service should be able to be mapped. This is so because the existing strategy is based both on the service and the application. The relationship between the business processes can be determined using the previous business process mapping for each service.

Based on 8 services provided by the Ministry of Health, the platforms for Citizen Health and Indonesia Health Services will be mapped. The platform is made up of the primary services of primary care, secondary care, and health resilience as well as the supporting functions of pharmacy and household health supplies, health human resources, health financing, internal management, and biotechnology, according to the value chain diagram shown above.

The services in the support functions are chosen based on the business processes that can assist in achieving the goals of each business process in the main function, while the services in the main functions are chosen based on the

business processes from both platforms to create value or benefits for the users (Figure 1.2).

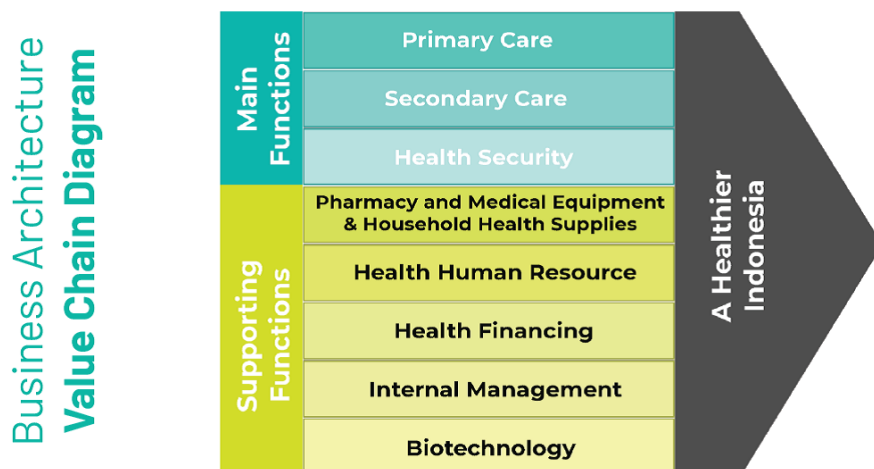


Figure 1.2. Business Architecture Value Chain Diagram

### b. Data Architecture

The goal of the data architecture is to standardize data in order to facilitate application integration and data interoperability. As a result, at the district/city, national, and international levels, the data produced by distinctive and diverse information systems at the organizational level can be merged and used.

These interoperability and data integration problems have been recognized on a global scale. The challenge has so far been addressed by developing a standardized framework that enables data consistency and interoperability. Fast Healthcare Interoperability Resources (FHIR) and OpenEHR are two widely used frameworks used in healthcare environments. Both are open standards with the aim of achieving standards and data interoperability, although they are made to address slightly different issues.

By offering a straightforward REST API, FHIR is designed to solve data interchange issues. The usage of resources that can be utilized for a variety of purposes is the basis of FHIR. These tools are typically used to share clinical data, such as meeting notes (Encounter), treatment schedules (CarePlan), and order of diagnosis. With its implementation, FHIR users can combine (bundle) more than 100 resources to create a database that meets their needs.

OpenEHR, on the other hand, is designed to provide a data platform with an emphasis on data consistency as the major focus and API and data exchange as the secondary focus. OpenEHR leverages more than 300 archetypes to give a full set of data elements, in contrast to resource-based FHIR. This naturally increases OpenEHR's level of usability compared to FHIR.

The FHIR health data interoperability framework is used by this health data architecture. This framework was selected for a number of factors. The ability to communicate the data from various health care information systems is given importance by the present single health data platform. The design of FHIR, which emphasizes REST API for data interchange, is the best option. The data interoperability framework must be tailored to the demands of each user because the one health data platform is not intended to replace the current information system. In this instance, resource-based FHIR is thought to be simpler and more customizable for data interchange purposes than OpenEHR. Third, FHIR has a larger user base than OpenEHR, allowing for data transmission amongst members of a larger community. Several nations have used FHIR, including Malaysia, the Philippines, Australia, and the United States.

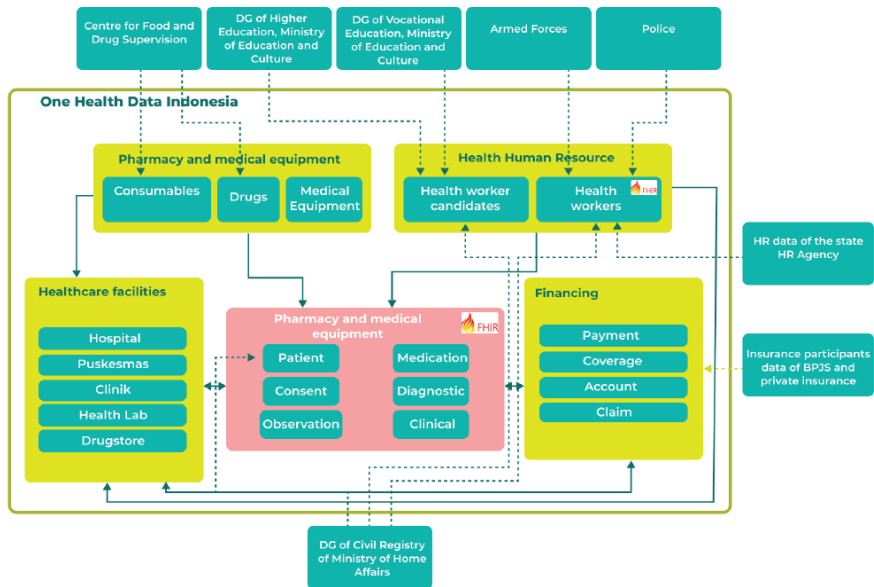


Figure 1.3. Data Architecture Logic Diagram

The Citizen Health App and Partner Systems are the two primary platforms used in the transaction process, which is where the One Health Data architecture gets its start. The Citizen Health App platform will deliver electronic personal health record information for users or patients, including users and other family members. With various data islands serving as supporting databases (yellow islands), the One Health Data architecture's primary goal is to compile information on all medical activities into a single, centralized Electronic Medical Record database (red island). Examinations, medical treatments, and clinical processes are only a few examples of the health service activities that are documented in electronic medical records. The supporting information, meantime, works to reinforce the core service information's context. Hospitals, public health centers, clinics, labs, and other institutions that provide health services are covered by the data island of health facilities. Information on medications or

medical equipment required for healthcare operations is available from the pharmacy and medical device data island. Health employees that provide health services are tracked by the data island of human resources for healthcare. Then, the finance island includes information that describes the expenses incurred and fees assessed for the medical services rendered. This medical record data will be safeguarded by the Data Ownership and Stewardship framework for data protection and security. Every data exchange transaction will include a layer of consent in addition to metadata and the data itself.

On the Partner Systems side, the primary aggregator to collect a single medical record data is the current health service facility management system (examples: Hospital Management Information System, Puskesmas Information System). Patient data, patient data sharing consent data, medical observation data, drug administration data, medical diagnosis data, and clinical action data are all included in medical record data. These medical record data are supplemented by information on healthcare facilities, which describes where the medical action occurred, information on health human resources, which describes who is performing the medical action, and information on financing, which describes the cost of the medical actions performed by BPJS and private insurance.

Data analysis can be done following the collection of a single electronic medical record. Examples of big data analytics include investigating the Indonesian hospitals that see the most patients, forecasting the development of epidemics on the island of Java, and categorizing therapeutic actions according to their geographic origin. Unstructured data analysis can also be done in addition to structured data analysis using tables, such as text mining analysis to determine the frequency of words in specific disease prescriptions or predictions using image processing to locate

tumors using observational medical record data from the CT scan image.

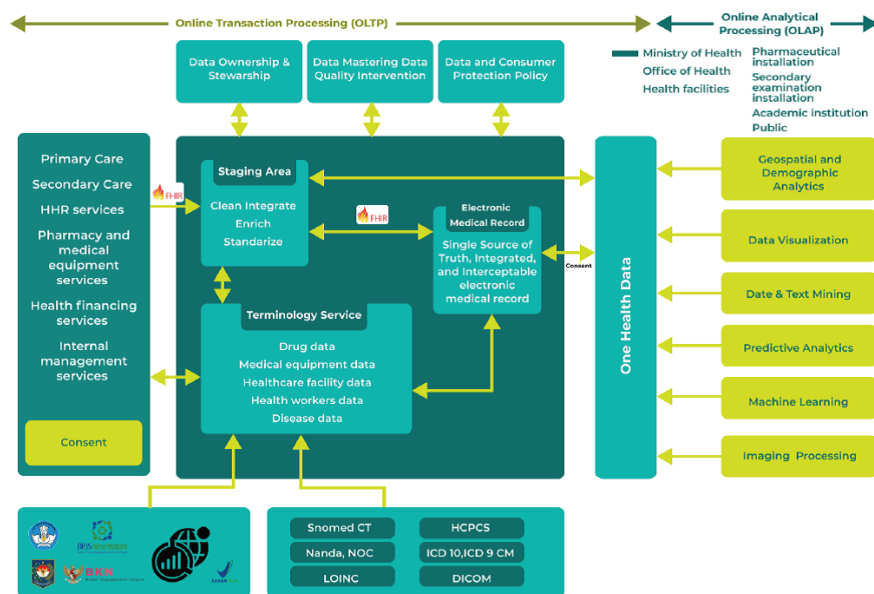


Figure 1.4. Data Architecture Conceptual Diagram

### c. Application Architecture

The IHS platform was created as a response to the previously mentioned latent issues with integration and a wide range of applications. IHS, as depicted in the graphic above, is a platform or ecosystem rather than a single program that allows all apps to connect to one another and be integrated into the same environment.

The IHS Platform is being developed using a modular strategy, where each service has its own purpose and setting. Each module has a database and logic (base service) that are used in the system to meet end-user needs and that make use of data that has been integrated and standardized. The citizen health app, which is customized for each user, or API-

to-API communication are the two main ways that data users are connected.

Utilizing cutting-edge big data analytics, including text mining and forecasting, integrated and standardized data will also be supported in order to improve health services in Indonesia offered by affiliated parties, through data marts that are updated in real-time.

Therefore, it is anticipated that the HIS Platform will enhance health services in Indonesia. Through the Citizen Health application, any time, any person can examine their own medical records. Service providers can utilize the One Health Data Indonesia system's data while also making periodic or ongoing contributions to the IHS ecosystem.

The IHS platform is made up of microservices modules based on the services offered and the primary requirements of the service recipients. Figure 1.5 displays the services. The primary and secondary care categories of services come first. The Puskesmas and hospitals, which make up this service group's primary healthcare providers, are catered to by the modules that make up this group. The services include everything from immunizations to the availability of hospital beds. Primary care practitioners and Puskesmas have developed and used numerous applications, necessitating the necessity for this module. The same is true for hospitals, as many employ their own systems to carry out their daily operations.

The second category of services includes those for pharmacies and medical equipment. Here, a variety of services are offered, including production licensing and distribution management. By facilitating quick access to data, these services are anticipated to enhance the pharmaceutical sector. The third category of services is finance services. This category includes modules and services that cover anything from capitation absorption data to service costing integration.



Internal Management Services and Health HR Services are the two subsequent courses, and they are both crucial. Typically, HHR services include offerings for both domestic and international health workers. Services are made available for hiring health professionals under IHS's HHR function. IHS additionally offers internal management service modules to supplement HHR services, which can be utilized to aid in the management of health care.

Biotechnology services are the sixth category of service. Because it is an ecosystem where anybody may participate in data utilization, this service is equally crucial to include in IHS. Services like access to Biobank and study and Innovation Hub make it possible to use data for scientific study and development.

Health resilience services, which are also offered by IHS, are the sixth category of service. The services include everything from the accessibility of ambulances to education and health promotion, both of which will be used in the last or eighth service, namely the Personal Health Record Service. This final service feature offers a thorough personal health record. In the future, the public will have access to some applications individually. Every service provider can access the modules and services contained in this function because it is a service-based function.

Health Service Providers (such as hospitals, public health centers, clinics, pharmacies, and laboratories) and related stakeholders (such as the Ministry of Health, health offices, and insurance) can access any combination of these microservices in accordance with established standard business process specifications. For instance, hospitals have access to all primary and secondary services, pharmacy services, and medical equipment services while clinics only have access to part of these microservices.



Figure 1.5. Modules Based on Health Services

### 5. Service Cluster Platform Solutions

A complete and inclusive digital health service will be created from the above mentioned problems and difficulties in each healthcare cluster, supported by an IHS Platform-based solution.

#### a. Primary and Secondary Carer

Establishing Indonesia Health Services (IHS) as a standardized and comprehensive data aggregator platform with a focus on the following solutions will enable the

effective, efficient, and sustainable realization of primary and secondary healthcare:

- 1) Offering electronic medical record (EMR) services or digital medical record data recording utilizing worldwide data standardization (FHIR, ICD-10, LOINC, SNOMED-CT, DICOM, intervention standards, diagnoses, and nursing outcomes, drug data standards).
- 2) The availability of the One Health Data service, a national health data warehouse with an API gateway to support health data interoperability.
- 3) Offer reliable health data to all parties involved in the health ecosystem as a foundation for their analysis of strategic policy-making.
- 4) Consolidation of apps from diverse health service providers onto a single platform based on microservices

The primary and secondary care platforms have eight modules for primary healthcare and one for service analytics. Three more important modules in primary care are focused on promoting public health. These modules, which are made up of microservices, are supported by base services as a common point of reference for data transfer. The primary module will be utilized to assist the fundamental process, while the analytical module will be used to streamline the reporting requirements for healthcare facilities.

Three extra modules on public health, family health, and environmental health are available for the primary care function. With initiatives including health education and promotion, family health, nutrition services, immunization, environmental health, disease prevention and control, hajj services, and disease control, the three modules complement the promotive and preventive roles that are the major responsibilities of primary health care facilities.

This method allows for the management of 56 existing secondary care applications and 75 existing main care applications with just 25 microservices each. As a result, this

system only needs 4 to 10 applications that are integrated with one another through the One Health Data platform to manage primary and secondary care activities. Both the general public and healthcare professionals acting in their capacities as managers and service providers at healthcare facilities will find this solution's design to be convenient. Platforms that allow health data interoperability are anticipated to provide continuous and rapid patient care while reducing the administrative burden on healthcare professionals.

A use case in a secondary care setting is illustrated in Figure 1.6. Patients who want to use telemedicine must first register in the relevant application in order to schedule medical consultations as needed. Prior to a doctor's examination, the patient will be required to complete an initial assessment, depending on the complaint. The doctor then determines the patient's diagnosis and, if required, provides medication. Patients can use the same program to redeem their prescriptions, and the online courier will promptly transport their medication from the neighborhood pharmacy to their home. The patient then receives a charge for the services that were rendered after that.

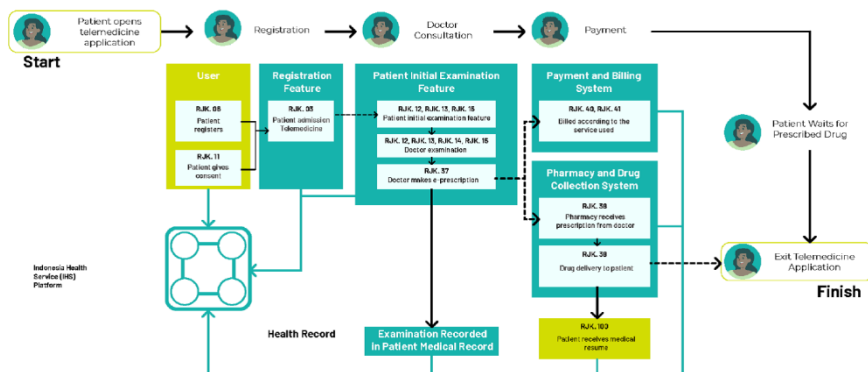


Figure 1.6. Illustration of Telemedicine Service Flow from Home

Patients will receive a medical report detailing the examination's findings, along with prescription notes and medical advice. All activity information is entered into the Indonesia Health Services (IHS) platform and connected to the patient's medical file.



Figure 1.7. Architecture Diagram of Primary Care Application

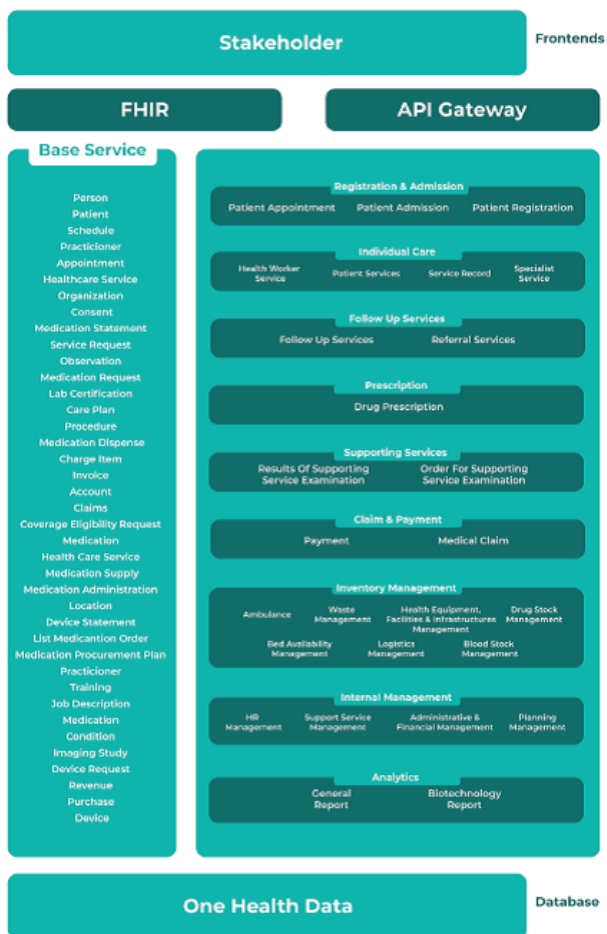


Figure 1.8. Architecture Diagram of Secondary Care Application

### b. Pharmacy and Medical Equipment Services

An integrated end-to-end supply chain management system is required in Indonesia to achieve robust pharmacy and medical equipment services. Prioritize the solutions listed below:

- 1) Standardization of firm codes with NIB standards from OSS (Online Single Submission), medical device & home health supply codes with standards from the Ministry of Health, and drug codes with BPOM standards.

- 2) Manufacturers, distributors, and healthcare facilities can connect their ERP (Enterprise Resource Planning) & inventory management systems to an open API using FHIR standards. Due to its low implementation costs and effort requirements, open API will lessen opposition from other agencies. Incentives for third parties in the form of free access data are required to encourage the adoption of open APIs.
- 3) The conversion of the manual recording system into a digital one with a networked system to guarantee a more precise monitoring of drug distribution and lower the risk of illegal drug circulation in society. creating an environment that enables third-party logistics providers to supply the required data in compliance with the mandated data standards for the pharmacy and medical equipment industries.
- 4) The integration of data from several sources into a single database for the pharmacy and medical equipment industries in order to avoid duplicative procedures. integrating the current systems with a single standard for health data

The platform for pharmacy and medical equipment services will include four key services: inventory management, supply-demand mapping, monitoring of license and compliance, and drug service and use. A service is controlled by the appropriate directorate of the Directorate General of Pharmacy & Medical Equipment (Dirjen Farmalkes) under each primary service. on order to aggregate data from various data touchpoints (producers, distributors, healthcare facilities, etc.), each core service will develop microservices and modules that will be supported on an aggregator platform. Aggregated data can be utilized to make strategic decisions and reduce bottlenecks in the medical supply and equipment supply chains. Apart from being used by regulators and policy makers, the aggregated data can also be used by partners

and actors in the pharmacy & medical equipment industry to forecast supply and demand more accurately to minimize stockout.

The aggregated data can be used by partners and participants in the pharmacy and medical equipment industry in addition to being used by regulators and policy makers to more correctly estimate supply and demand and reduce stockouts.

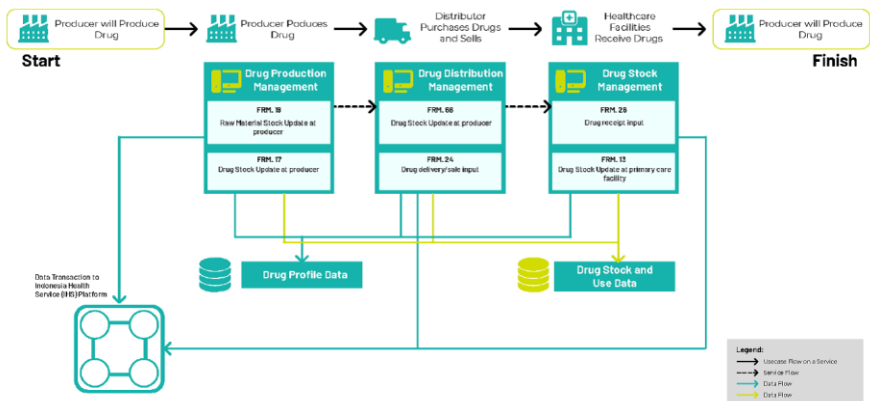


Figure 1.9. Illustration of Service Flow & Drug Supply Chain Data from Producers to Primary Health Care Facilities

Figure 1.9 depicts pharmacy and medical equipment services, namely the flow of medications from the producer to community health centers and patients. Once the required raw materials have reached the manufacturer's warehouse, manufacturers can begin producing medications. The manufacturer will update the drug stock after the medicine is created. Producers will send distributors any drugs that are legal to sell. The distributor will update the drug supply after receiving the medication. The medication is delivered to the medical facility after being ordered. The distributor will enter the delivery and sale of the medicine once it has left the warehouse. When a medication is received, the healthcare



facility will enter it. Drugs will be sold to patients when they are in need of them, and the medical facility will refresh its inventory of available medications.

### **c. Health Security Services**

The following issues need to be addressed in order of priority in order to create a comprehensive and effective health security system.

- 1) Bottom-up collection and use of all available data (demography, sociography, geography, social media, etc.), followed by advanced analytics processing to produce a precise mapping of disease risk from particular areas that enables agencies and stakeholders to take effective preventive action.
- 2) Developing a real-time early warning system and incorporating emergency case reporting with open access data to monitor the risks of health crises
- 3) Data format standardization for reliable, end-to-end integration using Open API. The lowest tier of healthcare institutions provide data, which is then collected and accurately analyzed to aid in strategic decision-making.
- 4) Reliable information sources that are simple to acquire and that promote health through an intuitive app experience

The Ministry of Health, part of the government, collaborates with many relevant parties across directorates general, ministries, and institutions to achieve health security. To provide a comprehensive and successful coordination, only one platform is required. The health security platform will be built using a number of main services that generate microservices & modules that are then supported in an aggregator platform to aggregate data from various data touchpoints (health facilities, laboratories, pharmacies, individual diagnosis, data testing, tracing, tracking, and treatment, etc.). The ability to foresee health crises and outbreaks allows key stakeholders to rapidly and effectively

plan their finances, human resources, and logistics in order to minimize losses and financial costs.

An illustration of a health security service, including a vaccine certificate and PCR or swab test verification, is shown in Figure 1.10. A travel permission must be prepared in advance for patients who will travel. Patients must first register for vaccinations by providing identity information, after which they will receive a schedule. According to the schedule, immunizations will be administered to patients after a health assessment and before AEFI monitoring. Health Human Resources then entered the patient's immunization information. On the PeduliLindung customer platform, patients can examine vaccination results and certifications for travel requirements. The healthcare facility will enter the patient's test results once they complete a PCR or antigen swab, and they will be stored in a database together with the patient's name. The patient can present a vaccination certificate and negative PCR or antigen test results from the PeduliLindung customer platform to the appropriate officer for check-in purposes.

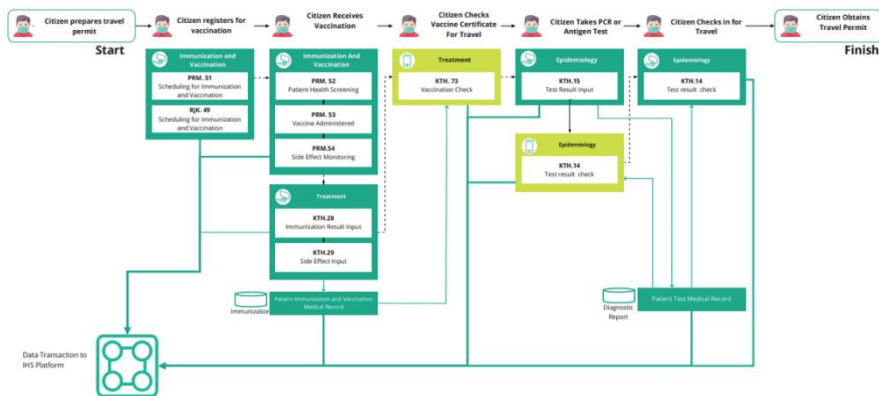


Figure 1.10. Illustration of Service Flow for Vaccine Certificate & PCR Test Verification

#### **d. Health Human Resource Services**

Planning and carrying out follow-up actions that address the complete issue is important to address the numerous obstacles in implementing HHR in order to ensure that the solution is accurate and offers solutions. The following categories of services apply to the solutions.

1) Integrated HHR profile management based on individual data.

Each stakeholder, in this case a health education institution, has the ability to provide information about student profiles, which will give stakeholders a general idea of the potential pool of HHR applicants in the future. A large data information system is also available, and HHR can immediately access it.

2) HHR distribution analysis based on integrated real time data

Big data will enable the information system to examine HHR distribution and pinpoint imbalances or gaps in a region or among certain healthcare facilities. Big data makes it feasible to locate every HHR in Indonesia, together with their location, number, level of experience, and competency, enabling a quicker response to HHR demands in the event of an outbreak.

3) Supervision and training with a centralized curriculum that can be accessed directly by HHR

The Ministry of Health is required to offer a platform for all professional associations or outside parties to enhance HHR abilities and skills, including for Competency Tests, Registration Certificates (STR), Practice Permits (SIP), training, and scholarships. Here, the Ministry of Health can act as a single point of contact for data on the services that each stakeholder offers.

The management of individual HHR data is the basis for the platform's primary process, which is data analysis. The information was acquired from the One Health Data Indonesia database, which houses all individual HHR data.

According to the FHIR standard, the created and processed data are anticipated to flow through the API services gateway.

#### **e. Health Financing Services**

Analysis must be carried out in accordance with the actual needs if data and information on national health finance and expenditures are to be met. The following four components make up the solutions.

Processing, analysis, and data gathering for all national health finance initiatives. For all national health initiatives, a base must be established for data processing, information, and expenditure analysis on both a macro (Supply Side Financing) and micro (Demand Side Financing) scale.

Standardized data from medical facilities is used to adjust service fees and capitation. We require a platform that has full digital data collection capabilities. Data that doesn't satisfy the requirements of the system will be automatically eliminated through standardization of the inputted data. New capitation norms and tariffs that will be used on a national level can be the analysis' output.

One platform for all sources of health financing. The unification of all data collection on a single platform through the integration of the most recent data with operational systems. In order to guarantee that all analysis will be centralized and based on the most recent validated data, this is crucial.

Administration of user profiles for all independent funds and health insurance customers. Through this platform, administrative tasks may be centralized and give those who utilize health insurance directly more advantages.

Seven service modules are included in the financing service application: participation in health insurance, analysis from healthcare facilities, additional budgeting administration, analysis of national, provincial, and district health accounts,

distribution of the health insurance fund, year-end administrative report, and health financing complaint.

#### **f. Internal Management Service**

The Ministry of Health is dealing with a number of internal management-related concerns. The high number of internal apps being used, such as the e-Renggar application for planning and budgeting services, e-Monev for monitoring and evaluation, e-Office for staff, and other applications, is the first problem and leads to inefficient data input. The second issue is that there is still no integration of the data across all internal applications. The Ministry of Health is working to create a service architecture that will be accessible to all staff members at the Ministry, Health Polytechnic (Poltekkes), Center for Health Training (BBPK), National Hospitals, and Lab Centers in order to solve this issue. This modular technology can eventually be utilized to combine a database that is in tune and in line with the pertinent local and provincial health bodies.

Internal Operations, Auctions, Planning and Budgeting, Implementation, and Monitoring and Evaluation are the five key modules that make up the Internal Management application platform. Additionally, each module has a base service of its own that is based on the operational procedures of each service.

#### **g. Biotechnology Services**

##### **1) Biobank**

The Biobank Indonesia Data Warehouse (BIDW) is a system for collecting and sharing data that seeks to deliver real-time data by centralizing pre-clinical, clinical, genomic, and CMC data. The Ministry of Health (internal), the biotechnology-based health innovation ecosystem, and the Ministry of Health (external) will all be involved in this data collection process. With the addition of the general public, who may access some general information, the parties

participating in the data sharing process are the same as those involved in the data gathering process.

Primary and secondary healthcare is a part of the ministry of health (internal), as are initiatives for pharmacy, medical technology, and health security. The biotechnology-based health innovation ecosystem includes startups that have advanced past the hackathon stage and were created for the biotechnology service of the Ministry of Health. The startup is a biotechnology-based company that can create consumables, wearables, or services as well as do data collection at BIDW. External parties involved in research and innovation include BRIN, Science Techno Park, Universities, Academic Hospitals, Independent Researchers, R&D Industries, Biotechnology Startups, and Biobanks (Universities, Private, BRIN).

The Scientific Advisory Board will be in charge of collecting the necessary data, which consists of 52 data sets from the MIABIS (Minimum Information About Biobank Data Sharing) standard and comprehensive papers in the form of Bio Standard and Biosecurity. The Data Access Committee will then carry out the data sharing process based on cybersecurity and IT, with seven processes for submitting data access requests (Norlin et al., 2012).

## **2) Biotechnology-Based Health Innovation Ecosystem**

Long-term progress in biotechnology has been made in Indonesia, however progress is typically modest because of a number of key reasons. The absence of funding for biotechnology-related research is the first factor. To increase both the quantity and quality of products as well as understanding about biotechnology, biotechnology research is required. Lack of personnel, infrastructure, and governmental regulations that extend the marketing of genetically altered products are further problems.

Agriculture, health, and the environment all benefit from biotechnology. Biotechnology helps enhance agricultural

production, improve food quality, and lessen food emergencies in the agricultural sector. Biotechnology has the ability to identify genetic and non-genetic disorders and treat some conditions. By using biotechnology in the environmental field, dirty surroundings can be made better by bioleaching, bioremediation, reducing plastic waste by creating bioplastics, and creating environmentally friendly biofertilizers.

Agriculture, health, and the environment can all benefit from biotechnology. Biotechnology helps the agricultural sector produce more food, enhance food quality, and lessen food crises. Biotechnology can identify genetic and non-genetic problems and treat some illnesses. Through bioremediation, bioleaching, reducing plastic waste by creating bioplastics, and creating environmentally friendly biofertilizers, biotechnology can enhance the quality of polluted surroundings.

To that aim, the major goals of the Biotechnology Services platform are to:

- a) Improve biotechnology products in Indonesia.
- b) Align academics with business.
- c) Offer a data repository for biotechnology items.
- d) Supply a biotechnology product data warehouse.
- e) Tighten up the oversight of biotechnology.

The Ministry of Health's provider can keep an eye on registered businesses, researchers, and the volume of transactions when building the biotechnology platform. To keep customers engaged after the launch of this platform, extensive communication is required. An ecology that can meet these needs is developed through public education. The two primary issues with biotechnology services are as follows:

- a) The data is still dispersed, the amount and quality of the data is low, as well as sectoral egos. The Ministry of Health plans to construct a Biobank Indonesia Data

Warehouse to address this issue. It is essential to establish a Scientific Advisory Board to oversee the data gathering process and a Data Access Committee to oversee the data utilization process.

- b) The biotechnology industry's importance and efforts to integrate Biobank nationally are not well known by the general public. The Ministry of Health wants to strengthen the Biotechnology-based Health Innovation Ecosystem to address this issue. This includes the Collaborative Sandbox, which serves as a discussion space, the Startup Hackathon, which serves as a platform for product innovations based on consumable, wearable, and service-based goods, and the Startup Hub & Capital Providers, which brings together innovators and capital providers.

The Biobank Indonesia Data Warehouse, Collaborative Sandbox, Hackathon Biotechnology, and Start-Up & Capital Providers Hub are the four main services offered by the Biotechnology Application. Every service has unique modules. The modules for VTTO Registration and Product Registration can be found in the Start-Up and Capital Providers Hub. There are three elements that make up the Biotech Hackathon service: Playground, Research and Innovation Hub, and Product Submission. Only the Topic Sandbox module is included in the Collaborative Sandbox service, while the Biobank service is made up of the Biobank Registration, Single Sign-On, Sample Submission, Sample Data, and Sample Data Access modules.

Biotechnology Services will divide all modules into two services based on the corresponding databases. An ecosystem based on biotechnology and health will become a single database with user and provider platforms, and the Biobank Indonesia Data Warehouse will have its own database.





## Exercise

Explain the next task with your own perspectives for better understanding about digital transformation.

1. Describe the goals of the health technology transition.
2. Describes the creation and integration of health data;
3. Describes the development and integration of health applications.
4. Described how to strengthen the ecosystem for health technology.
5. Described the governance of the company for digital transformation Republic of Indonesia's Ministry of Health



## Summary

The implementation of a digital health transformation strategy aimed by 2024 is significantly hampered by the merger of eight health services. The existence of numerous applications for health services, which spread health data without a uniform format, is one of the main problems that occur. Due to a lack of information readiness and follow-up action implementation, this condition threatens the security of the national health system. For instance, choices and policies are not adequately targeted since information on the readiness of hospital beds, medications, and medical equipment, as well as health professionals throughout Indonesia, is not based on real-time data and is wrong.

To realize the goal of a Healthy Indonesia, the Ministry of Health needs the support of all players in the health sector. The Ministry of Health is the primary actor in this effort. The implementation of a digital health transformation strategy must also

be supported by data and a coordinated network of healthcare providers.

The development of applications for health data and services as well as the enhancement of the sustainable health technology ecosystem will be the main goals of the digital health transformation strategy. These are anticipated to enhance data quality and strategies to boost health services' effectiveness. Through this mapping, all health services can be integrated to achieve maximum effectiveness and interoperability in primary and secondary care, pharmacies, and medical equipment, as well as internal management to innovation in the biotechnology ecosystem.

The platform-based approach is used to implement the digital health transformation strategy and is based on innovations in the construction of national health data. These innovations include service- and business-process-based platforms, standardization of architecture and specifications, collaboration of ecosystems for players in the health industry, open APIs based on microservices, and compliance through integration of mutual benefits through ease of service and integrated information. The Indonesia Health Services (IHS) Platform and the Citizen Health App are two products of the plan for transforming digital health. The IHS platform was created as a response to underlying issues with the fusion of diverse applications. Complete personal health records are stored on the platform Citizen Health App.

The strategy for digital health transformation shifts the focus of health services in a direction that makes them simpler and more accessible to the general population, boosting efficiency since access to high-quality, easily usable health data is straightforward and convenient. The transformation of digital health technology will result in a higher-quality health service system with a focus on measurable implementation based on current maps, which will promote more economic growth. Thus, the Blueprint for the Digital Health Transformation Strategy is here to address the issues, opportunities, and challenges of Indonesia's digital transformation in order to offer thorough, doable, and quantifiable solutions in the creation of sustainable health services..



Choose the correct answer:

1. The use of telemedicine is related to the government's goal of achieving minimum Universal Health Coverage (UHC) ..... among all people.
  - A. 80%
  - B. 85%
  - C. 90%
  - D. 95%
  
2. The principles of developing Partner Systems as a breakthrough in developing national health data, namely:
  - A. Need based platform
  - B. Standardization of architecture and specifications
  - C. Health ecosystem collaboration
  - D. Macroservices-based Open API
  
3. Applications that are included in the primary service is ....
  - A. Educator
  - B. Health promotion
  - C. Individual health efforts
  - D. Epidemiological investigations
  
4. Data gathering and sharing system to support the centralization of pre-clinical, clinical, genomic, and CMC data that aims to provide real time data is .....
  - A. Biobank Indonesia Data Warehouse (BIDW)
  - B. Fast Healthcare Interoperability Resources
  - C. Base Services
  - D. BIO

5. A data exchange service that serves as a bridge to connect between users (community, providers, and stakeholders) and the IHS platform is ....
- A. Microservices
  - B. Macroservices
  - C. Application Programming Interface
  - D. Fast Healthcare Interoperability Resources

Check your answers with the answer key on the formative test at the end of this module. Count the correct answers. Then, use the following formula to determine your mastery level of module 1 material.

$$\text{Level of Mastery} = \frac{\text{number of correct answers}}{\text{number of questions}} \times 100$$

The meaning of the level of mastery:



If you reach 80% or more mastery, you can continue with Learning Activity 2. Good! If you are still below 80%, you must repeat the material for learning activity 1, especially the parts you haven't mastered yet.

Keys:

- 1. D
- 2. B
- 3. C
- 4. A
- 5. D

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## UNIT II

# HEALTH MANAGEMENT INFORMATION SYSTEM

### **Learning Objectives:**

After taking this chapter, you'll be able to:

4. Explain the health information system
5. Explain the health management information system
6. Explain the health technology transformation
7. Explain the health technology enterprise architecture

### **A. Introduction**

Health information systems (HIS) belong to the IT industry, which contributes to the global economy providing jobs for IT specialists and increasing tax revenues from activities related. The development of medical engineering and technologies in general and HIS in particular is related to changes in the needs of the healthcare industry including a steady increase of knowledge in the medical field, complexity of the examination, diagnostic, and treatment methods.

### **B. Health Information System**

HIS is an information system for processing data, information, and knowledge in healthcare environments. It can be defined as an integrated effort to collect, process, report, and use health information and knowledge to influence policy-making, program action, and research (Jakovljević, 2008). A Health Information System is a collection of structures that includes data, information, indicators, procedures, devices, technology, and resources. Health

information is health data that has been processed or processed into a form that contains value and meaning that is useful for increasing knowledge in supporting health development. Integrated management of interconnected human resources to guide activities or choices that support the growth of health (Dash et al., 2019).

Health informatics (HI) is a subset of informatics, just like construction informatics, visual informatics, intelligence and security informatics, or organizational informatics (Turk, 2006). The University of Edinburgh considers informatics as the study of the structure, behavior, and interactions of natural and engineered computational systems (University of Edinburgh, 2023). For a more thorough understanding of health informatics, it is important to highlight a few historical aspects related to its root: information technology.

The International Medical Informatics Association and American Medical Informatics Association (AMIA) define health informatics as the science of how to use data, information, and knowledge to improve human health and the delivery of healthcare services (AMIA, 2023). Health Informatics is the integration of healthcare sciences, computer science, information science, and cognitive science to assist in the management of healthcare information (Saba & McCormick, 2015). The tools of informatics are likely to be clinical guidelines, formal medical languages, information systems, or communication systems like the Internet.

Health informatics has also been recognized and referred to as medical informatics, clinical informatics, or biomedical informatics. It includes a number of areas, such as telehealth, telephone triage and telecare, telenursing and remote guidance, teleradiology, teledermatology, medical monitoring, Holter monitoring, automated ECG interpretation, patient registration, digital radiology, Picture Archiving and Communication System (PACS), Clinical Decision Support Systems (CDSS), computer-aided diagnosis, concept processing (artificial intelligence, machine learning), robotic surgery, cyber knife, or clinical trials (Isaias, 2012). The construction of an infrastructure that can support the



application of various technologies in healthcare is explored in greater detail by health informatics. The extent of the healthcare technology or information that is being dealt with serves as the fundamental dividing line between the many types of health informatics. For instance, the information systems and technologies employed in nursing practice are the focus of telenursing. The range of informatics specialties is typically narrow and deep, but from a distance, health informatics is a profession that works with the application of technology to handle complex issues, keep track of massive amounts of data, and enhance decision-making procedures.

The adoption of health information systems has been prompted by the present digitalization and revolution of healthcare. The global unrest that has affected a number of linked sectors has further fueled the demand for and potential of these healthcare systems (Epizitone et al., 2023). Health Information Systems are a crucial part of every country's healthcare system and cannot be separated from it. In order to generate data for decision-making in relation to the management of health services at the health system stage, the Health Information System is a phase and pattern. An information system is essentially a collection of activities that start with data collecting, data processing, data assessment, and information transmission needed to administer and regulate health services. Information systems are used for research and training purposes. A system made up of data, information, parameters, steps, devices, technology, and human resources that is connected and controlled systematically as material to consider when making decisions that are helpful in promoting health development is referred to as a health information system (Herawati et al., 2022).

Hospitals now have health information systems in place, which is a sign of advancement in both information technology and medicine. As a result, public health has improved, healthcare standards have been upgraded, and life expectancy has greatly increased. The process of running healthcare organizations and information systems has an impact on this development. While

hospitals frequently modify their health information systems to lessen mistakes involving patient misidentification, the rise in the frequency and documentation of medical mistakes in Lebanon caused by incorrect patient identifications shows that such measures are still insufficient for unknown reasons (Popescu et al., 2022).

Health informatics and nursing informatics are very relevant in evolving health systems. New technology and initiatives are constantly being developed. These new innovations do not go without implications in the clinical setting, managerial setting, and the policy setting. It is crucial that all participants whether it is the nurse, manager, provider, politician, lobbyist, or government remain coordinated. Multidisciplinary unity is crucial to ensure public trust in our health systems and to provide safe and effective patient care (Sweeney et al., 2017).

### **C. Health Management Information System**

Health management information system (HMIS) is a system whereby health data are recorded, stored, retrieved and processed to improve decision-making. HMIS data quality should be monitored routinely as production of high quality statistics depends on assessment of data quality and actions taken to improve it (Endriyas et al., 2019). The American Health Information Management Association (AHIMA) defines health information management as the practice of acquiring, analyzing, and protecting digital and traditional medical information (AHIMA, 2023). It is a combination of business, science, and information technology.

Both at the macro (country) and the micro (patient) levels, the health information management system is crucial. Healthcare facilities require timely patient information from a variety of sources at the point of care in order to offer the best possible care at the patient level (Adane et al., 2019). They also require a comprehensive, complete, and fully functional system to meet all of these requirements. Data on health at the national level aids the government in developing various initiatives and policies to improve

population health (Baba et al., 2018). One approach to do this is through using information and communication technology (ICT) in healthcare. ICT is a tool that makes it easier to share knowledge electronically, process information, and communicate. ICT includes all forms of electronic digital and analog ICT, excluding non-electronic ones, including radio, television, computers, fixed and mobile phones, and electronic-based media like digital text and audio-video recording. It should be mentioned that the use of ICT does not diminish the value of non-electronic methods, such as paper-based text, for knowledge sharing and health communication (Oo et al., 2021).

The application of ICT into existing health systems has helped to improve the delivery of health care in a number of ways (Khelfaoui et al., 2022). The review identified three main information and communication technology (ICT) application areas for the technology acceptance model (TAM) in health services: telemedicine, electronic health records, and mobile applications (Rahimi et al., 2018). The benefits of the application of ICT in health care include the use of telemedicine to improve diagnosis and enhance patient care, improvements in the continuing professional development of health workers and better sharing of research findings through e-health, and the use of health systems as an effort to extend the reach and coverage of health care to make an impact on specific conditions (Hailegebreal et al., 2022). ICT is the basis for the development and operation of information systems and enables the creation and application of knowledge. This consists of different levels of sophistication and complexity of information systems, within the health care system for: patient records, tracking of disease prevalence, monitoring drug supplies, maintaining ordering systems for supplies, and billing procedures therefore all benefit from the use of ICT (Chetley et al., 2006).

#### D. Differences Between Health Information Systems and Health Management Information Systems

A professional with a degree in either Health Information Management (HIM) or Health Informatics (HI) should possess a variety of domains and competences at the entry level of the workforce, according to research conducted throughout time. Numerous similarities and some discrepancies between academic education in HIM and HI are found when comparing the current domains and competencies published by AHIMA and AMIA. Data structure and content, information technology, data analytics, information security, leadership, management, and project management are just a few of the areas that both HIM and HI specialists must be knowledgeable with, as shown in Figure 2.1.

A good experience in medical coding, healthcare reimbursement and finance, revenue cycle management, health legislation, risk management, and adherence to numerous healthcare policies and regulations is also demanded of HIM specialists. Professionals in HI are anticipated to have a much deeper understanding of technology and to be experts in terms of computer science and information technology.

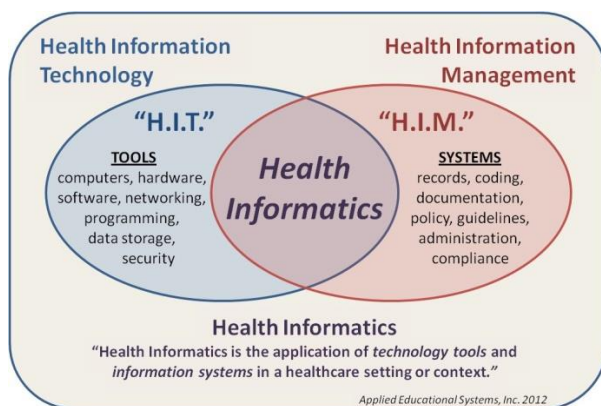


Figure 2.1. Differences between scope of Health Information Technology and Health Information Management (HIMT - IAU, 2016)

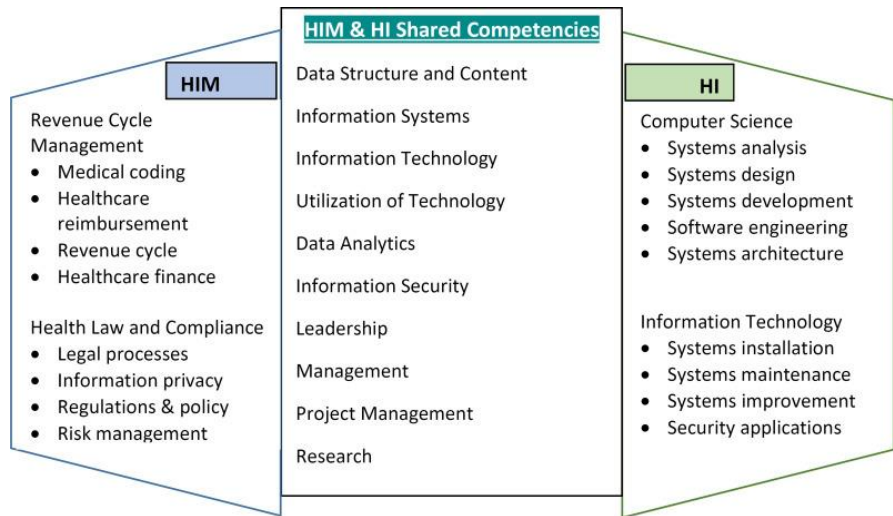


Figure 2.2. Differences between Health Information Management and Health Information Technology Competencies

## E. Components of Information Systems

The six main parts of an information system are the following: hardware, software, network connections, data, people, and procedures. Everybody has a specific function, and for the information system to function, all functions must cooperate. The first four elements in this book are categorized as technology. When it comes to using a variety of technologies to achieve particular organizational goals, people and processes are the two factors that provide value to firms (Laudon & Laudon, 2004).

### 1. Hardware

The physical elements that make up an information system are represented by hardware. Others exist inside a gadget and can only be viewed by opening the device's case, while some can be seen or touched without opening the device. Examples that are readily apparent include keyboards, mouse, pens, disk drives, iPads, printers, and flash drives. Hardware that lies inside a computer case and is typically hidden from view from the outside includes motherboards, internal memory chips, and computer chips.

## 2. Software

Software is a collection of directives that specify what the hardware should do. You cannot touch software since it is not physical. By using a specific procedure to submit a list of instructions that specify what the hardware should perform, programmers develop software programs. There are many different types of software, but the two most prevalent types are operating-system and application software. Operating system software acts as a bridge between the hardware and the application, shielding the programmers from the details of the underlying technology.

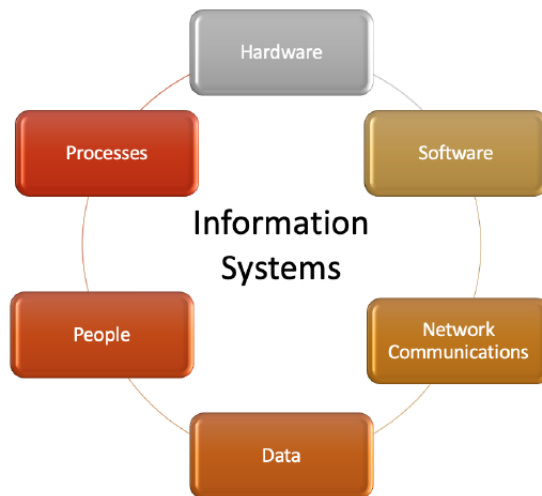


Figure 2.3. Components of Information Systems

## 3. Network connections

The fundamental building blocks of information systems are often regarded as being hardware, software, and data. Conversely, other people think networking communication belongs in a separate category and is a component of an IS. Even without communication, an information system is still possible. For instance, the first computers used for personal use were standalone devices without Internet connectivity. Nevertheless, since their creation, information systems have changed. As an illustration, all of our gear and

software up until recently was for desktop operating systems. Today's environment, however, includes mobile OS in the operating system software and other hardware devices besides desktops in the hardware category. It happens very infrequently for a computer device to be disconnected from a network or another computer device.

#### **4. Data**

Data is the third component. Data can be viewed as a collection of uncontested basic facts. For instance, your first name, driver's license number, city of residence, pet's photo, voice clip, and phone number are all examples of raw data. Although you can see or hear your facts, they don't by themselves provide you with any further significance. For instance, you may be able to read a person's driver's license number and identify it as such, but you are unaware of any other information about the individual. Those are the kinds of things IS would generally need to get from you or other sources. However, after being combined, indexed, and logically arranged using software like a spreadsheet or database, the raw data will reveal fresh information and insights that a single raw fact cannot. A suitable example is the preceding example of gathering all expenses (i.e., raw data) to produce an expense tracker (new information obtained). In fact, the definitions provided at the beginning of this chapter were all concerned with data management. Organizations gather a variety of data, process it, and organize it in some way before using it to inform choices. The organization can then be improved after these decisions have been evaluated for effectiveness.

#### **5. People**

Computers were created by humans for human use. across order to assist enterprises create value and increase productivity, information systems are developed and managed across a wide range of areas, including:

- a. Users are the individuals who actually utilize an IS to carry out a task or job function. Examples comprise: a student uses a spreadsheet or a word processing software program.
- b. Technical developers are the ones who produce the technology that go into creating an information system. Examples include a software programmer, an application programmer, and a computer chip engineer.
- c. Business professionals are CEOs, owners, managers, entrepreneurs, and employees who utilize information systems to launch or grow their companies and carry out job duties including accounting, marketing, sales, human resources, and customer service, among others. Famous CEOs like Marc Benioff of Salesforce, Steve Jobs of Apple, Bill Gates of Microsoft, and Jeff Bezos of Amazon are a few examples.
- d. IT Support: These specialist experts are educated to maintain the information systems in order to assist the business and protect it from unauthorized intrusions. Network analysts, help desk support, and support for data centers are some examples.

## **6. Process**

Process is the final element of information systems. A business process is a set of actions taken to realize a particular result or objective. Businesses need to constantly innovate in order to either increase profits by offering new goods and services that satisfy client demand or to reduce operating costs. Technology must be used to do more than just automate tasks. Organizational processes and information systems are increasingly being connected to provide benefits for revenue-generating and cost-saving actions that can provide businesses a competitive advantage over their rivals. Business process reengineering, business process management, enterprise resource planning, and customer relationship management are examples of specialized standards or processes that have to do with the ongoing development of these



business procedures and the integration of technology in order to increase internal efficiencies and better understand customer needs. Businesses are very focused on this information systems component in an effort to outperform their rivals.



### Exercise

Explain the next task with your own perspectives for better understanding about digital transformation.

1. Describe the health information system
2. Describes the health management information system
3. Describes the differences between health information system and health management information system



### Summary

HIM and HI are two similar but distinct disciplines. They share a common goal in terms of using information technologies and information power to improve the quality and efficiency of patient care; contribute to disease prevention and treatment; and improve overall population health. HIM professionals are primarily focused on managing health information, and HI professionals are primarily focused on the technologies and systems that make health information management possible. The right combination of the breadth of knowledge HIM professionals possess and the depth of knowledge HI professionals bring into the various areas constituting the scopes of the two disciplines can strengthen an organization's potential and growth in a complex, fast-changing healthcare environment.

In economics, innovation in technology is seen as a way to increase production and improve efficiency. It is certainly true in the health care market, which is highly information intensive and thus would highly benefit from good information management. For example, advances in information technology allow for the near-immediate adjudication of claims at pharmacies. HIT is one of the most important innovation in the health care industry, due to its potential advantage at lowering cost, monitoring and surveillance, and reducing medical errors. More and more researchers and policy makers are beginning to take great interest at this low adoption pace issue. Health care information technology consists of various categories. The most common and widely discussed ones include the Electronic Medical Record (EMRs). It contains digital format of patients' medical information, for example medical history, medication, nursing care, laboratory test results and other clinical data. EMRs is to replace traditional paper-based hand written medical record, which makes it easier to read and keep track of patients' history information. Moreover, digital record can be transferred between care providers more convenient and faster. Within the EMRs category, there are several particular applications. Health care Information and Management Systems Society (HIMSS) Foundation define in their HIT dataset since 2005 of EMRs as consisting of Clinical Data Repository, Clinical Decision Support System (CDSS), Computerized Practitioner Order Entry (CPOE), Order Entry (Includes Order Communications), Physician Documentation, Nursing Documentation, and Physician Portal.



Choose the correct answer:

1. HIT stands for?
  - A. Health Information Terminology
  - B. Health Information Transcription

- C. Health Information Technology
- D. Health Information Tables

2. Why is electronic access to test, lab, surgery, and x-ray results so important?
  - A. it allows client to see results
  - B. avoiding delays and costs associated with re-testing improves client care
  - C. healthcare professionals can quickly provide diagnosis
  - D. information can be loaded into the system quickly
3. What is meaningful use?
  - A. When clients request that healthcare providers implement EHR systems
  - B. A financial investment program used to help healthcare providers reduce practice costs
  - C. A program for healthcare providers to earn money for using electronic documents in their practices
  - D. A financial incentive program to encourage national use of EHR technology in order to improve client care
4. What is the purpose of Electronic Health Records (EHRs) in the healthcare industry?
  - A. Storage and sharing of patient data
  - B. Confidentiality of patient data
  - C. Encryption of patient data
  - D. Security of patient data
5. What is the main purpose of Health Information Management (HIM) in the healthcare industry?
  - A. To reduce medical errors
  - B. To improve patient care outcomes
  - C. To ensure compliance with government regulations
  - D. To ensure accuracy and reliability of patient data

Check your answers with the answer key on the formative test at the end of this module. Count the correct answers. Then, use the following formula to determine your mastery level of module 1 material.

$$\text{Level of Mastery} = \frac{\text{number of correct answers}}{\text{number of questions}} \times 100$$

The meaning of the level of mastery:



If you reach 80% or more mastery, you can continue with Learning Activity 2. Good! If you are still below 80%, you must repeat the material for learning activity 1, especially the parts you haven't mastered yet.

Keys:

1. C
2. B
3. D
4. A
5. D

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## UNIT III

# NURSING INFORMATICS

### **Learning Objectives:**

After taking this chapter, you'll be able to:

1. Explain the health information system
2. Explain the health management information system
3. Explain the differences between health information systems and health management information systems
4. Identification of components of information systems

### **A. Introduction**

Nursing is progressively impacted by digital technologies worldwide. Examples include the increasing prevalence of artificial intelligence (AI) and autonomous systems; the reliance of society on mobile, internet, and social media; and the increasing reliance on telehealth and other virtual models of care, particularly in response to the covid-19 pandemic. Despite substantial advancements made to date, the use of digital technology in nursing continues to present obstacles. The fact that nurses have not generally kept up with the rapid evolution of digital technologies and their influence on society is a recurrent concern. This reduces the prospective nursing practice and patient care benefits of these technologies. To address these challenges and prepare for the future, nursing must immediately transform into a digitally enabled profession that can address the complex global challenges confronting health systems and society (Booth et al., 2021).

Numerous examples demonstrate that digital technologies already benefit nursing practice and education (Krick et al., 2019).



Telehealth programs in which nurses provide daily surveillance, coaching, and triage for patients with multiple chronic diseases, for instance, have contributed to a decline in emergency department visits (van Berkel et al., 2019). Mobile devices, specifically smartphones and health applications, enable nurses to provide remote pain management advice to adolescent cancer patients using mobile devices (L. Jibb et al., 2020; L. A. Jibb et al., 2017) and supplement aspects of nursing education by providing innovative pedagogical solutions for content delivery and remote learning opportunities (Chuang et al., 2018).

Artificial Intelligence (AI) system development and application in nursing are still in their infancy. However, preliminary evidence suggests that virtual chatbots could play a role in streamlining communication with patients, and robots could increase the emotional and social support patients receive from nurses, despite inherent challenges such as data privacy, ethics, and cost efficacy (Buchanan et al., 2020; Robichaux et al., 2019).

Nurses utilizing Health Information Technology (HIT) in an acute care, chronic care and community setting are occurring at an unprecedented rate (Drexler, 2020; Jahnke et al., 2021). Despite the benefits and financial investment of electronic medical records (EMRs), the transition and implementation has created challenges for nurses. These challenges are further complicated when nurses fail to communicate documentation issues to the designers of the electronic record. Nurses manage these issues by creating workarounds. The consequences of workarounds have been noted as negative and a potential for medical errors (Lalley, 2014).

Nursing leaders are well positioned to address these challenges and facilitate a more effective change process for nurses. Successful nursing leaders have been able to achieve these outcomes through the implementation of professional governance (Drexler, 2020; Gottlieb et al., 2021; Twigg & McCullough, 2014). Evidence shows a positive impact on nurse satisfaction when a professional governance structure is in place and guides the professional practice of nurses specific to autonomy

and accountability. Additionally, evidence also revealed that nurses have a desire to be included in the quality of design, implementation, and sustainability of electronic documentation. An opportunity existed to evaluate incorporating a professional nursing governance accountability structure into a current shared governance (SG) structure to determine the impact on nursing satisfaction and professional role accountability and ultimately action related to the electronic record documentation system (Drexler, 2020; McCord et al., 2022).

HIT has been promoted as an integral component of quality, safe, and efficient health-care delivery (Buntin et al., 2011). Data science brings new insights when large-scale datasets are brought together to characterize and address complex problems. The past decade has seen a plethora of federal and private investments in biomedical data science collection, organization, and analysis (Brennan et al., 2018).

Using a variety of digital platforms, artificial intelligence, and other cutting-edge technologies, the Future of Nursing 2020 to 2030 Report expressly encourages the integration of nursing expertise in designing, generating, analyzing, and applying data to support initiatives focused on social determinants of health and health equity (National Academies of Sciences et al., 2021). The paper also comes to the conclusion that in order to implement its recommendations, nurses must have technological skills in areas like telehealth, digital health tools, and data analytics. A research agenda and evidence base describing the impact of nursing interventions, including multisector collaboration, on social and environmental health, health equity, and nurses' health and well-being are also called for in the report. Beyond these particular, utilizing current data sources and creating new ones are required to create the metrics needed to enable and assess progress on all recommendations. Additionally, data must be altered and integrated into information systems to aid in important stakeholders' communication, information sharing, and decision-making.

The report's informatics and data science implications are broad (Brennan et al., 2018). This chapter is to reinforce and expand the report's content. The recommendations of the Future of Nursing 2020 to 2030 report will be examined through an interdisciplinary lens that integrates nursing, biomedical informatics, and data science by addressing three critical questions: (a) what data are needed?, (b) what infrastructure and processes are needed to transform data into information?, and (c) what information systems are needed to "level up" nurse-led interventions from the micro-level to the meso- and macro-levels to address social (Bakken & Dreisbach, 2022).

Nursing Informatics (NI) is a term derived from the French word "Informatique" which alludes to the field of applied computer science concerned with the processing of information such as nursing information. The computer was viewed as a versatile instrument that could be utilized in numerous settings. In the early 1960s, computers were introduced into health-care facilities for the processing of administrative duties. Thus, began the computer revolution in health-care, which led to the HIT and/or electronic health record (EHR) systems of today. Data recovery, ethics, patient care, decision support systems, human-computer interaction, information systems, imaging informatics, computer science, information science, security, electronic patient records, intelligent systems, e-learning, and telenursing are among the numerous additions to the field. The American Nurses Association (ANA) introduced Nursing Informatics as a specialty that incorporates nursing science, computer science, and information science to provide data communication management, nursing knowledge, and nursing labor in 2001. The majority of nursing personnel perceive it to be the integration of information technology with all aspects of nursing, including clinical nursing, management, research, and education (Dar et al., 2022).

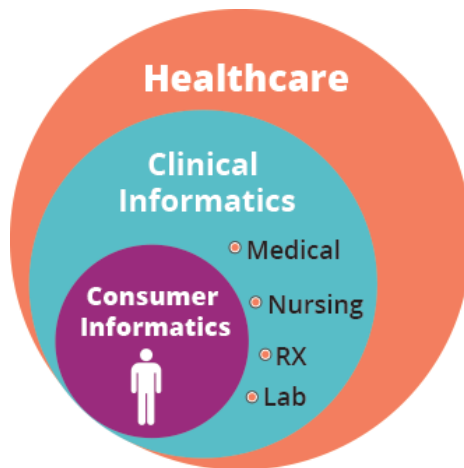


Figure 3.1. Consumer Informatics

Source: <https://digitalhealth.casn.ca/modules/module-one/module-1-consumer-informatics-do-you-know-what-it-is/>

There are a number of different definitions of informatics; the three listed here are the ones most frequently used. The American Nurses Association (ANA) defined NI as **“the specialty that integrates nursing science with multiple information and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice”**. Examples of how these might be used are discussed in the following text. NI supports nurses, consumers, patients, the interprofessional health-care team, and other stakeholders in their decision-making in all roles and settings to achieve desired outcomes. This support is accomplished through the use of information structures, information processes, and information technology (IT).

The American Medical Informatics Association (AMIA) defines consumer health informatics as **“the field devoted to informatics from multiple consumer or patient views. These include patient-focused informatics, health literacy and consumer education”**. NI refers to **the specific structure, organization and communication of data, information, and knowledge relevant to**

**nursing practice supported by the use of technology.** In addition, it addresses the role of nurses' in system design, implementation, adoption, and evaluation. The focus of this type of informatics is different; it emphasizes "information structures and processes that empower consumers to manage their own health—for example health information literacy, consumer-friendly language, personal health records, and Internet-based strategies and resources".

The ANA's informatics framework incorporates the advancement of population health outcomes. When nurses have a level of informatics competency, they are better able to manage patients' complex medical data and provide high-quality patient care, as well as support consumers, the interprofessional health-care team, and other stakeholders in their decision-making across all roles and settings to achieve desired outcomes. As developers of communication and information technologies, researchers, chief nursing officers (CNOs), chief information officers (CIOs), software architects, implementation consultants, and policy developers, nurse informaticists advance health care. Information structures, information processes, and IT are utilized to provide this assistance.

Other definitions vary, but generally speaking, nursing informatics is the integration of computer science and nursing science to convey "data, information, knowledge, and wisdom in nursing practice". As a result of the extensive use of technology, every aspect of nursing practice falls under the category of an informatics nurse (IN), regardless of board certification.

Nursing theories comprise ideas and connections that help to construct a framework. Nursing informatics can be defined as systems, cognitive, and change theories.

1. Systems theory: Systems theory examines interdependent components within defined boundaries and is visible in the usage of technology and patient body systems.
2. Cognitive theory: Input, output, and processing are all related to cognitive theory.

3. Change theory: The dynamic processes that are combined with nursing informatics are examined using the change theory approach.

## **B. Components of Nursing Informatics**

Combining nursing, information, and computer science results in nursing informatics. Patient-centered care is one of the main concerns in the nursing profession. Technologies is used by nurses to improve care in a variety of ways, including communication technologies to coordinate care, data management to assess and improve care outcomes, information for evidence-based practice, and the usage of electronic records. The following is the nursing information component:

1. Components of Nursing Informatics include nursing science, computer science, and information science, which are used to manage and communicate data, information, knowledge, and wisdom into nursing practice.
2. Nursing science is a branch of science concerned with the fundamentals and applications of nursing and related services.
3. The study of computation, automation, and information comprises computer science. Computer science encompasses both theoretical and practical disciplines. Computer science is generally regarded as a field of academic research distinct from computer programming.
4. Information science (also known as information studies) is a discipline that focuses on the analysis, collection, classification, manipulation, storage, retrieval, dissemination, and preservation of information.
5. These three components are combined to compose nursing informatics.

The Centers for Medicare and Medicaid Services (CMS) offers incentive payments to qualified hospitals and providers for the meaningful use of certified health information technology products under the Patient Protection and Affordable Care Act and the

American Recovery and Reinvestment Act of 2009 (ARRA). To enhance health-care quality, safety, coordination, and communication, meaningful use is required for hospitals and providers.

The three elements of meaningful use of an Electronic Health Record (EHR) in a meaningful way using EHR technology for electronic information sharing and submitting clinical quality measures. Fourteen core objectives and 15 clinical quality indicators are required for reporting in stage one of meaningful use for hospitals, and 16 core objectives and six hospital menu objectives are required in stage two.

### **Meaningful Use Hospital Menu Objectives Stage 1**

1. Drug-formulary checks
2. Record advanced directives for patients 65 years or older
3. Incorporate clinical lab test results as structured data
4. Generate lists of patients by specific conditions
5. Use certified EHR technology to identify patient-specific education resources and provide to patients, if appropriate
6. Medication reconciliation
7. Summary of care record for each transition of care/referrals
8. Capability to submit electronic data to immunization registries/systems
9. Capability to provide electronic submission of reportable lab results to public health agencies
10. Capability to provide electronic syndromic surveillance data to public health agencies

### **Meaningful Use Core Objectives Stage 1**

1. Computerized provider order entry (CPOE)
2. Drug-drug and drug-allergy interaction checks
3. Record demographics
4. Implement one clinical decision support rule
5. Maintain up-to-date problem list of current and active diagnoses

6. Maintain active medication list
7. Maintain active medication allergy list
8. Record and chart changes in vital signs
9. Record smoking status for patients 13 years or older
10. Report hospital clinical quality measures to CMS or States
11. Provide patients with an electronic copy of their health information, upon request
12. Provide patients with an electronic copy of their discharge instructions at the time of discharge upon request
13. Capability to exchange key clinical information among providers of care and patient-authorized entities electronically
14. Protect electronic health information

Computerized physician order entry, patient demographics, vital signs, medication reconciliation, drug interactions, allergies, smoking status, clinical decision support, interdisciplinary communications, advance directives, confidentiality, transitions of care, patient education, and the ability for patients to get a copy of their EHR are all included in the definition of meaningful use as it relates to electronic health records. Nurses must be critical stakeholders in planning, designing, implementing, assessing, and optimizing health IT as the meaningful use criteria change.

### **New Technology Adoption by Nurses**

The environments in health-care have evolved to incorporate more than a physical location. There is an increase in the use of mobile computers, wireless solutions, and automated exchanges between health-care providers and patients. Adapting to these new environments necessitates a paradigm shift in how care is communicated and provided, necessitating an understanding of the evolution of new technologies. Nurses are at the heart of this development as the professionals who provide the greatest quantity of direct patient care.

Virtual office visits, online appointment scheduling and payment, mobile laboratories, and electronic medication prescribing are commonplace in modern health-care settings. In addition,



nurses play a crucial role in assisting patients in creating their health records (PHRs) and educating them on how to use a patient portal. The use of telehealth exchanges is on the rise, especially among underserved rural populations. Access to and opportunities for providing quality care to patients in remote locations are made possible by new technologies. The challenge for these technologies in health-care is ensuring that the automated solutions interact fully with one another and with the health-care professionals who use them.

### **C. Scope of Nursing Informatics**

From the era of technological and scientific progress, Nursing Informatics has grown deeper roots in both clinical and academic nursing. Following is a summary of the scope of nursing informatics:

#### **1. Promotion of health**

Patient care is the service provided by the nursing care industry. Today, clinical nursing information systems, decision support systems, and medical diagnostic systems are associated with accumulating patient information, storing this information, and then retrieving the same information with the aid of nursing informatics. Regarding the technologically advanced environment, health care and hospital information system developers, the standard of care is rising. Nursing informatics contributes to the improvement of patient safety and is leading to evidence-based nursing.

#### **2. Advance systems**

Advanced systems are provided by nursing informatics to reduce the likelihood of errors resulting from a lack of time or resources. Since thirty years ago, decision support systems designed to aid physicians in solving problems requiring specific decisions have been developed by advanced systems. It is superseding the function of human knowledge by incorporating it into the system. Expert systems and artificial intelligence are the

most beneficial types of clinical decision support systems and have applications in show notes, diagnostic support, critical treatment plans, decision support, prescriptions, recovery, and the identification and interpretation of images; however, they cannot replace human expertise as standalone tools.

### **3. The Global Nursing Association**

It is possible to establish a common network for nursing organizations and a forum for discussing nursing issues and organizing online meetings on the World Wide Web. In addition to telemedicine and telenursing, the potential for nursing practice in the coming decade also includes remote care. Software and hardware designed for uncomplicated remote diagnostics are intended to facilitate E-health services. Tele-nurses can provide various services via the Internet, including education, patient monitoring, and counseling. Telenurses are satisfied with their positions. Utilizing specialized skills and knowledge, they administer care remotely. It can address the global shortage and demand for nurses. Most nurses who participated in a survey about telenursing believed that it is preferable to design educational programs to prepare nurses for telenursing practice. Utilizing online library resources and outreach programs would benefit nurses and lead to favorable outcomes. Information and communication technology advancement has made it possible for e-education to enhance health at any time and in any location.

### **D. Competencies of Nursing Informatics**

The Technology Informatics Guiding Education Reform (TIGER) Initiative was established in 2004 for the purpose of collaborating with nursing stakeholders to develop a vision, action plan, and strategies to enhance nursing education, practice, and patient care delivery through the use of health information technology. The TIGER Informatics Competency Collaborative defines the recommended competencies for the NI field.

### **Competency: Basic Computer Skills**

Specific competencies for basic computer skills identified by TIGER include:

1. Information and communication technology concepts
2. Computer use and managing files
3. Word processing
4. Spreadsheets
5. Database use
6. Presentation
7. Communication and web browsing

### **Competency: Information Literacy**

TIGER identified specific competencies for information literacy:

1. Establish the character and extent of the information needed
2. Efficiently and effectively access needed information
3. Appraise information and the sources critically, and integrates appropriate information into his/her knowledge base and value system
4. Use information effectively, as an individual or team member, to achieve a specific purpose
5. Evaluate outcomes of information use

### **Competency: Information Management**

The competencies recognized for the category of information management include:

1. Verbalize the importance of health information systems with clinical practice.
2. Have knowledge of types and clinical and administrative uses of health information systems.
3. Ensure confidentiality of protected patient health information.
4. Assure access control in the use of health information systems.
5. Ensure the security of health information systems.
6. Have user skills, including navigation, decision support, and output reports.

7. Understand the principles of health information system use by health-care professionals and consumers are based.

### **Responsibilities within Nursing Informatics**

Nurse informatics have different roles and responsibilities in health-care, each bringing value to the provision of patient care. Identified responsibilities of nursing informatics include:

1. Analyze both clinical and financial data
2. Endorse and facilitate resource and reference access
3. Deliver nursing content to standardized languages
4. Improve continuity of care
5. Enhance relationships between providers and patients
6. Support cost savings and goals for productivity
7. Sustain nursing work processes using technology
8. Redesign clinical workflow
9. Assist with change management
10. Encourage provision of high quality, evidence-based care
11. Facilitate true interdisciplinary care

### **E. Roles within Nursing Informatics**

Roles for nurse informatics have grown over the years. A few examples include:

1. Leadership, including management and administration
2. Analysis
3. Integrity and compliance management
4. Consultation
5. Patient care coordination
6. Data integration
7. Educational and professional development
8. Policy development and advocacy
9. Research and evaluation
10. Systems integration
11. Clinical application support
12. Process and workflow design
13. Clinical transformation

14. Information technology security
15. Clinical champion
16. User training

## **F. Opportunities in Nursing Informatics**

Opportunities in nursing informatics encompass all specialties in acute care, home health, ambulatory care, long-term care, outpatient settings, telehealth, software development, and workflow redesign. The Healthcare Information and Management Systems Society (HIMSS) made nursing informatics recommendations based on the IOM report. These recommendations include participation in nursing leadership, education, and practice.

1. **Leadership:** HIMSS proposes a partnership with nurse administrators to lead technological changes that promote health and health-care delivery, support the development of informatics departments, and promote the growth of the Chief Nursing Informatics Officer position.
2. **Education:** For education, suggestions include transforming nursing education to include informatics competencies and behaviors at all levels of academic preparation and promoting continuing nursing education at all levels, especially in the areas of health IT and EHRs.
3. **Practice:** Recommendations for nursing informatics with practice include the incorporation of informatics competencies into practice standards and facilitating the collection and analysis of health-care workforce data by gathering data from existing health IT systems.

## **Applying Nursing Informatics**

1. **Practice:** Knowledge of nursing information systems can be applied to nursing practice, including patient documentation, monitoring devices, developing and implementing care plans and pathways, retrieving previous records and imaging, utilizing telehealth, and gaining access to current practice standards.

2. Administration: Information systems are utilized for communication, staff scheduling, cost and budget analysis, and monitoring of quality and customer satisfaction trends.
3. Education: The applications of informatics and technology in education include simulation, electronic learning, teleconferencing, and the availability of software for educational presentations and programs.
4. Research: internet capabilities and electronic databases provide rich access to obtaining, compiling, and conducting research.



### Exercise

Explain the next task with your own perspectives for better understanding about digital transformation.

1. Explain the difference between nursing informatics and health informatics
2. Describe the components of nursing informatics
3. Describe Applying Nursing Informatics



### Summary

The development of digital technologies that seek to make health-care safer and more efficient has resulted in a rapid transformation of the health-care industry. As a result, health informatics has evolved to include nursing informatics, which integrates nursing, information and communication technologies (ICT), and professional knowledge to enhance patient outcomes. New terminology has emerged to describe informatics and its processes, but it is generally misunderstood. This paper will

describe current nursing informatics definitions from Australia, the United States of America, and Canada to identify similarities and differences between these definitions and summarize the distinct bodies of knowledge described by each country. These nations have some of the earliest definition attempts in literary history. This narrative review adopted a pragmatic approach, working backward from historical references and forward from more recent references extracted from published health and nursing informatics literature.



Choose the correct answer:

1. Which of the following is the protection of information against threats to its integrity, inadvertent disclosure, or availability?
  - A. Privacy
  - B. Survivability
  - C. Confidentiality
  - D. Information security
  
2. The informatics nurse who takes on which of the following roles provides expert advice, opinions, and recommendations based on their area or expertise?
  - A. Product developer
  - B. Researcher
  - C. Consultant
  - D. Educator
  
3. Which descriptions are advantages of health-care information technology (IT). Select all that apply:
  - A. Increases health-care delivery costs
  - B. Decreases the safety of providing care
  - C. Improves communication among providers
  - D. Increases time necessary to document care

4. The hospital has implemented a new electronic Medication Administration Record (MAR). What is true about the use of this new tool?
  - A. Verifies medication dosages
  - B. Reduces med administration errors
  - C. Eliminates the need to count narcotics
  - D. Requires a hard copy of MAR to be printed
  
5. Which activity by a unit nurse demonstrates information literacy?
  - A. Researching a patient's diagnosis online
  - B. Entering patient data into the Electronic Health Record (EHR)
  - C. Learning a new Electronic Health Record (EHR)
  - D. Organizing patient data to study trends

Check your answers with the answer key on the formative test at the end of this module. Count the correct answers. Then, use the following formula to determine your mastery level of module 1 material.

$$\text{Level of Mastery} = \frac{\text{number of correct answers}}{\text{number of questions}} \times 100$$

The meaning of the level of mastery:





If you reach 80% or more mastery, you can continue with Learning Activity 2. Good! If you are still below 80%, you must repeat the material for learning activity 1, especially the parts you haven't mastered yet.

Keys:

1. D
2. C
3. C
4. B
5. A

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## UNIT IV

# CLINICAL DECISION SUPPORT SYSTEMS IN NURSING

### **Learning Objectives:**

After taking this chapter, you'll be able to:

1. Explain the Clinical Decision Support Systems (CDSS)
2. Identification of the functions and benefits of CDSS
3. Identification of the hidden difficulties of CDSS
4. Explain the Clinical and Nursing Decision Making Process and Implementation
5. Explain the High-Reliability Organizing (HRO)
6. Explain the CDSS Five Rights Framework

### **A. Introduction**

Numerous techniques and interventions, both computerized and non-computerized, are included in clinical decision support. Clinical guidelines and digital resources such as ClinicalKey® or UpToDate® for clinical decision assistance are examples of non-computerized tools. These clinical decision support systems, or Clinical Decision Support Systems (CDSS), are classified as information management instruments. Attention-focused tools make up a different kind of CDSS, commonly referred to as basic or simple clinical decision support systems. CDSS can positively influence selected aspects of nurses' and other professions' performance and care outcomes. Comparative research is generally of low quality and outcomes are wide-ranging and heterogeneous.

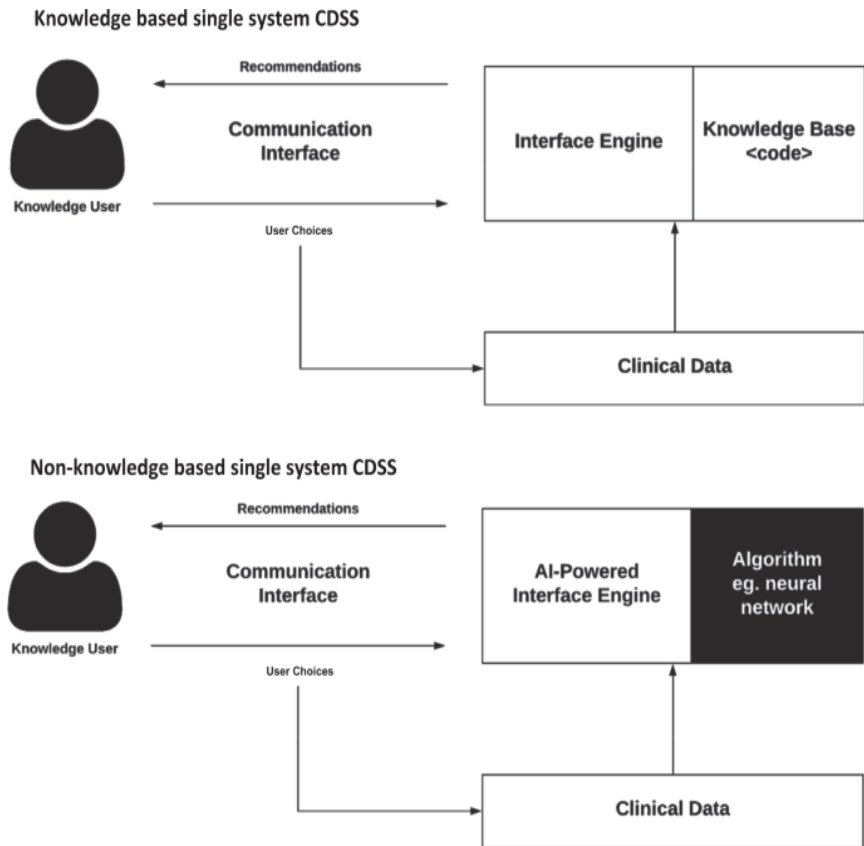
## **B. Clinical Decision Support Systems (CDSS)**

A clinical decision support system (CDSS) aims to enhance medical decisions by providing specific clinical knowledge, patient data, and other health information (J. Osheroff et al., 2012). When a patient's characteristics are matched to a computerized clinical knowledge base, software is created specifically to be a direct aid to clinical decision-making. Patient-specific assessments or recommendations are then presented to the clinician for a decision (Sim et al., 2001). At the point of care, CDSSs are largely employed nowadays so that the physician can combine their expertise with data or recommendations from the CDSS. However, more and more CDSS are being created that may use information and observations that are often unavailable to or difficult for humans to understand.

The earliest computer-based CDSSs are from the 1970s. They were time-consuming, had poor system integration, and were frequently restricted to academic endeavors at the time (Shortliffe & Buchanan, 1975). The use of computers in medicine, physician autonomy, and who would be responsible if a recommendation made by a system with a deficient level of "explainability" were also discussed as ethical and legal issues (Middleton et al., 2016). Currently, CDSS frequently use web apps or interaction with electronic health record (EHR) and computerized provider order entry (CPOE) systems. They can be administered using a laptop, tablet, or smartphone as well as additional gadgets including biometric monitoring and wearable health technologies. These devices might or might not be connected to EHR databases or create outputs directly on the device itself (Dias & Paulo Silva Cunha, 2018).

CDSSs have been classified and subdivided into various categories and types, including intervention timing, and whether they have active or passive delivery. CDSS are frequently classified as knowledge-based or non-knowledge based. In knowledge-based systems, rules (IF-THEN statements) are created, with the system retrieving data to evaluate the rule, and producing an action or

output (Berner, 2007); Rules can be made using literature-based, practice-based, or patient-directed evidence (Yang et al., 2020). CDSS that are non-knowledge based still require a data source, but the decision leverages artificial intelligence (AI), machine learning (ML), or statistical pattern recognition, rather than being programmed to follow expert medical knowledge. Non-knowledge based CDSS, although a rapidly growing use case for AI in medicine, are rife with challenges including problems understanding the logic that AI uses to produce recommendations (black boxes), and problems with data availability (Deo, 2015). They have yet to reach widespread implementation. Both types of CDSS have common components with subtle differences, illustrated in Figure 4.1.



They are composed of (1) base: the rules that are programmed into the system (knowledge-based), the algorithm used to model the decision (non-knowledge based), as well as the data available, (2) inference engine: takes the programmed or AI-determined rules, and data structures, and applies them to the patient's clinical data to generate an output or action, which is presented to the end user (e.g. physician) through the (3) communication mechanism: the website, application, or EHR frontend interface, with which the end user interacts with the system 9.

Figure 4.1. Diagram of key interactions in knowledge-based and non-knowledge based CDSS (Sutton *et al.*, 2020)

According to (Omidian & Hadianfard, 2011), the range of services offered by CDSS is extensive and includes diagnostics, alarm systems, disease management, prescription (Rx), drug control, and much more. They may appear as electronic alerts, reminders, order sets, patient data reports, templates for documentation, and clinical workflow tools (Kabene, 2010). The potential and actual benefits of each CDSS function will be covered in detail throughout this review, along with any unanticipated negative effects and mitigation techniques.

## **C. Functions and Benefits of CDSS**

### **1. Patient safety**

CDSS is frequently applied in medication error reduction strategies (Table 1). Up to 65% of inpatients may be exposed to one or more potentially dangerous combinations, according to research on drug-drug interactions (DDI), which is noted as a common and preventable error (Vonbach et al., 2008). CPOE systems are currently created with drug safety software that incorporates protections for dosing, duplication of medicines, and DDI checks (Helmons et al., 2015). These systems' warnings are some of the most often used types of decision assistance (Koutkias et al., 2018). However, studies have discovered a significant degree of variation in the algorithms used to identify DDIs, how warnings for DDIs are prioritized, and how they are displayed (e.g., passive or active/disruptive). There is no standard for how to implement which notifications to providers in systems where varied degrees of irrelevant alerts are frequently presented (D. S. McEvoy et al., 2017).



Table 1. Clinical Decision Support Systems (CDSS) advantages, potential risks, and evidence-based prevention techniques

Functions and advantages of CDSS	Potential harm of CDSS	Solution(s) to mitigate harm	Explanation of solution(s)
<p><b>Patient Safety</b></p> <p>Reducing the frequency of drug/prescription mistakes and adverse event occurrence</p>	<p><b>Alert fatigue</b></p> <p>A phenomenon where too many insignificant alerts or CDSS recommendations are presented, and providers start to dismiss them regardless of importance.</p>	<p>Prioritize critical alerts, minimize use of disruptive alerts for non-critical indications.</p>	<p>Alert fatigue might be thwarted by prioritizing and selecting alerts that are critically important, that will have the greatest impact, and by tailoring alerts to specific specialties and severities (personalization) (A. M. J. W. Scheepers-Hoeks et al., 2009)</p> <p>DDI testing software should ideally be programmed with an algorithm that incorporates concomitant medication, lab values, patient demographics, and administration times, to be as specific as possible (Helmons et al., 2015)</p>
<p><b>Clinical management</b></p> <p>Adherence to clinical guidelines, follow-up and treatment reminders, etc.</p>	<p><b>Negative impact on user skills</b></p> <p>One example is reliance on, or excessive trust in the accuracy of a system.</p>	<p>Avoid prescriptiveness in system design. Evaluate system impact on an ongoing basis.</p>	<p>Systems should be set up to be useful to clinicians, without jeopardizing autonomy or being too 'prescriptive' and definitive. It is important to conduct analysis to see how the system is being used in the long term, after implementation. If accuracy is an issue, design changes might need to be taken to prompt extra checks or confirmation of orders (Ash et al., 2007)</p>
<p><b>Cost containment</b></p> <p>Reducing test and order duplication, suggesting cheaper medication or treatment options, automating tedious steps to reduce provider workload, etc.</p>	<p><b>Financial challenges</b></p> <p>Setup can be expensive (capital or human resource), and long-term cost-effectiveness is not guaranteed.</p>	<p>Design and plan for longitudinal cost analysis at the outset. Specify measurements for non-financial benefits where possible.</p>	<p>An analysis should be done to determine if the costs are justified and if there is a good return on investment. Cost analysis is notoriously missing in the literature, but examples can be found. Payers may be more willing to support CDSS if cost-savings can be shown elsewhere in the system/process. This means looking at more than just direct costs a using metrics such as patient outcomes or quality-adjusted life years (QALY) (Jacob et al., 2017; Okumura et al., 2016; Vermeulen et al., 2014)</p>
<p><b>Administrative function/ automation</b></p> <p>Diagnostic code selection,</p>	<p><b>System and content maintenance challenges</b></p> <p>As practice changes, there can be difficulty</p>	<p>(1) Knowledge Management (KM) Service in place, with a focus on translation to</p>	<p>(1) Facilitates scheduled review, methods for acquiring and implementing new knowledge, and streamlined processes for gathering physician</p>

Functions and advantages of CDSS	Potential harm of CDSS	Solution(s) to mitigate harm	Explanation of solution(s)
automated documentation and note auto-fill.	keeping the content and knowledge rules that power CDSS up to date.	CDSS systems.  (2) System for measurement and analysis of CDSS performance.	feedback on the system as well as training users on why certain data entry and standardization of data entry practices. Standards for organizing KM management have been published (J. A. Osheroff et al., 2007)  (2) It is important to identify changes in performance and use over time. In addition, the quality of the data repository should be monitored and it is also important to ensure that conclusions are not being made on corrupted or poor quality data beforehand (Mebrahtu et al., 2021)
<b>Diagnostics support</b>  Providing diagnostic suggestions based on patient data, automating output from test results.	<b>User distrust of CDSS</b>  Users may not agree with the guideline provided by the CDSS.	Reference expert knowledge—include scientific references in messages where appropriate.	To provide a verifiable source of information to the user on why the recommendation exists. In addition to increasing trust, this may provide direction for users to update their knowledge in case they were not aware of the recommendation (Bates et al., 2003)  Many systems also query reasons for not following a recommendation in order to elucidate the source of mistrust (Kawamoto et al., 2005). This is a good idea, but should not be mandatory or 'bulky' in design.
<b>Diagnostics Support: Imaging, Laboratory, and Pathology</b>  Augmenting the extraction, and interpretation of medical images and laboratory test results.	<b>Transportability/interoperability</b>  CDSS face challenges regarding integration with other hospitals or systems, making it inefficient for otherwise high-quality systems to be disseminated and scaled.	Adoption of industry standards.  Secure cloud services and blockchain.	Major open standards for structural and semantic interoperability and exchange continue to be developed and improved by organizations such as Health Level 7 International (HL7), SNOMED International, Digital Imaging and Communications (DICOM) for imaging standards, and many others. As much as possible, these standards should be adopted at all levels within the healthcare organization, and with the external systems being used (Marco-Ruiz & Bellika, 2015; Resource Center, 2023)  Cloud-based EHR architecture allows for more open architecture, and flexible

Functions and advantages of CDSS	Potential harm of CDSS	Solution(s) to mitigate harm	Explanation of solution(s)
			connectivity between systems. As with any medical system, security must be assured through compliance with legislation such as Health Insurance Portability and Accountability Act (HIPAA) in the USA, Personal Information Protection and Electronic Documents Act (PIPEDA) in Canada, and the Data Protection Directive and General Data Protection Regulation (GDPR) in Europe. In the future, we may also see blockchain used to enable greater interoperability and improve security for health information exchange (HIE) (Agbo et al., 2019; Angraal et al., 2017)
<p><b>Patient decision support</b></p> <p>Decision support administered directly to patients through personal health records (PHR) and other systems.</p>	<p><b>Dependency on computer literacy</b></p> <p>CDSS may require a very high technological proficiency to use</p>	<p>Conform to existing functionality.</p> <p>Adequate training made available at launch.</p>	<p>(1) Maintaining consistency with the user interface of the pre-existing system (if there is one) is crucial to ensure users don't have a steep learning curve to use the system.</p> <p>(2) Adequate training should be available and easily accessible for users. Training should ideally be done in person by a clinician leader with vast EHR experience to generate buy-in (Eichner &amp; Das, 2010). Training needs to be available on an ongoing basis, as new staff and users join. One strategy is to have on-site team members designated as elite users, and capable of providing training sessions.</p>
<p><b>Better Documentation</b></p>	<p><b>Inaccurate and poor-quality data/documentation</b></p> <p>CDSS may aggregate data from multiple sources that are not synced properly. Users may develop manual workarounds that compromise data.</p>	<p>Expert Knowledge of interlinked systems.</p> <p>IT testing/ debugging during development and implementation stage.</p>	<p>The team needs to be familiar and have expert knowledge of all external systems that feed data into the database used by the CDSS.</p> <p>Experts recommend testing clinical rules for PPV and NPV during the process of development and implementation (A. M. J. W. Scheepers-Hoeks et al., 2009). If user generated data is an issue, it may be that physicians</p>

Functions and advantages of CDSS	Potential harm of CDSS	Solution(s) to mitigate harm	Explanation of solution(s)
			have not received the proper training on how to read, interpret and respond to alerts, or are depending on pharmacists to check medication orders before dispensation
<p><b>Workflow improvement</b></p> <p>CDSS can improve and expedite an existing clinical workflow in an EHR with better retrieval and presentation of data.</p>	<p><b>Disrupted/fragmented workflow</b></p> <p>CDSS can also disrupt existing workflows if they require interaction external to the EHR, or don't match the providers' real world information processing sequences.</p>	<p>Usability evaluation.</p> <p>Workflow modeling.</p>	<p>(1) Rigorous and iterative usability evaluations and pilot testing should be conducted on CDSS before using them in clinical settings. Many usability assessment tools are available, along with other quantitative methods and frameworks (Westerbeek et al., 2021)</p> <p>(2) Unless a goal of the CDSS is to change the care process, the CDSS should be designed to fit within or conform to the current user workflows (Laka et al., 2022)</p>

Source: Sutton *et al.*, 2020

Electronic drug dispensing systems (EDDS) and barcode point of care (BPOC) medication administration systems are two further methods that aim to improve patient safety (Mahoney et al., 2007). Each step of the procedure (prescribing, transcribing, dispensing, and administering) is automated and takes place within a connected system when they are integrated together to produce a “closed loop.” Radio-frequency identification (RFID) or barcodes are used to automatically identify the drug at the time of administration, and patient data and prescriptions are cross-referenced. The possible benefit is the reduction of pharmaceutical delivery errors that occur at the “bedside” as opposed to further upstream, which presents another target for CDSS. Due in part to expensive and complex technological requirements, adoption is comparatively low (Peris-Lopez et al., 2011).

Reminder systems for medical occurrences other than medication-related ones help CDSS to increase patient safety. A CDSS for blood glucose testing in the ICU, for instance, was able to

reduce the number of hypoglycemic occurrences. This CDSS automatically reminded nurses to perform a glucose measurement in accordance with a regional glucose monitoring policy, which stated how frequently measurements should be performed in light of particular patient demographics and prior glucose levels/trends (Eslami et al., 2012).

Overall, CDSS focusing on patient safety through CPOE and other systems have been largely successful in reducing prescribing and dosage errors, contraindications through automated alerts, drug-event monitoring, and more. No matter the fundamental reason for the installation of CDSS, patient safety can be viewed as a secondary objective (or requirement) of practically all types of CDSS (Jia et al., 2016).

## **2. Clinical management**

Clinical guidelines can be more closely followed, according to studies (Kwok et al., 2009). This is crucial because it has been demonstrated that conventional clinical guidelines and treatment pathways are difficult to execute in practice with low clinician adherence (Cabana et al., 1999; D. A. Davis & Taylor-Vaisey, 1997). The presumption that practitioners will study new rules, internalize them, and apply them has not shown to be accurate. On the other hand, CDSS can really encode the rules that are implicitly contained in guidelines. These CDSS can come in a variety of shapes, including standardized order sets for a targeted case, alerts to a particular procedure for the patients it applies to, testing reminders, etc. Furthermore, CDSS can help manage patients on research or treatment regimens, track and place orders, follow-up for referrals, and ensure preventative care (Lipton et al., 2011; Salem et al., 2018).

Additionally, CDSS can notify doctors and nurses when a patient hasn't adhered to their treatment plans or needs to be followed up on. It can also assist in identifying patients who meet certain requirements for study eligibility (McCoy et al., 2014; Mebrahtu et al., 2021; Wasylewicz & Scheepers-Hoeks, 2019).

When a patient's record fulfills the criteria for a clinical trial, a CDSS developed and implemented at Cleveland Clinic notifies doctors at the point of treatment (Embi et al., 2005). The alert requests that the user fill out a form confirming eligibility and consent to contact, sends the patient's medical record to the research coordinator, and prints a clinical trial patient information page.

### **3. Cost containment**

Through clinical interventions (Calloway et al., 2013), lowering hospital length-of-stay, CPOE-integrated systems recommending less expensive drug options (McMullin et al., 2004), or lowering test duplication, CDSS can be cost-effective for health systems. A CPOE-rule that restricted the scheduling of blood count, chemistry, and coagulation panels to a 24-h window was put in place in a pediatric cardiovascular intensive care unit (ICU) (Algaze et al., 2016). Without affecting length of stay (LOS) or death, this lowered laboratory resource consumption at a projected cost savings of \$717,538 annually.

The CDSS can inform the user about less expensive drug alternatives or medical problems that insurance companies will pay for. A large number of hospital inpatients in Germany are moved to medications on hospital drug formularies. Heidelberg Hospital created a drug-switch algorithm and included it into their current CPOE system after learning that 1 in 5 substitutions were wrong (Zanaboni & Wootton, 2012). The CDSS could switch 91.6% of 202 prescription consultations automatically and flawlessly, improving safety, lowering provider workload, and saving money.

### **4. Administrative functions**

Clinical and diagnostic coding, ordering of treatments and testing, and patient triage are all supported by CDSS. A refined list of diagnosis codes can be suggested by designed algorithms to help doctors choose the most appropriate one or ones. In order to overcome the inaccuracy of ICD-9 emergency department (ED) admission coding, a CDSS was developed (ICD is an acronym for

International Statistical Classification of Diseases, which is a set of standardized codes used to describe diseases and diagnoses) (Bell et al., 2013). ED doctors could more quickly and reliably find diagnostic admission codes with the aid of a technology that integrated an anatomical interface—a visual, interactive representation of the human body—to ICD codes.

Clinical documentation quality can be directly improved by CDSS. In comparison to the control hospital, an obstetric CDSS with an improved prompting system considerably improved documentation of the reasons for labor induction and the estimated fetal weight (Haberman et al., 2009). Accurate documentation is crucial since it can directly support clinical processes. To address the increased risk of infections associated with splenectomy, such as pneumococcal, *Haemophilus influenzae*, meningococcal, etc., a CDSS was deployed, for instance, to make sure patients were fully immunized after splenectomy. The CDSS warning is set off when a patient's condition list contains the term "splenectomy," but the authors discovered that 71% of patients with this term in their EHR did not have it noted there. Then, in order to improve the problem list documentation of splenectomy and increase the usefulness of the first vaccine CDSS, a supplemental CDSS was created (D. McEvoy et al., 2018).

## **5. Diagnostics support**

CDSS are also referred to as diagnostic decision support systems (DDSS) for clinical diagnosis. Historically, these systems have offered a computerized "consultation" or filtering stage, where they may receive data or user selections and then produce a list of potential or likely diagnoses (Berner, 2006). Unfavorable physician attitudes and prejudices, low accuracy (frequently caused by gaps in data availability), and inadequate system integration necessitating manual data entry are just a few of the reasons why DDSS haven't yet had as much of an impact as other types of CDSS (Segal et al., 2017). With better EHR integration and

standardized terminology like Snomed Clinical Terms, the latter is improving.

A good example of a successful DDSS is one created for the fuzzy logic-based identification of peripheral neuropathy (Kunhimangalam et al., 2014). They outperformed specialists in diagnosing motor, sensory, mixed neuropathies, or normal cases with 93% accuracy using 24 input fields that comprise symptoms and diagnostic test results. Even if this is very helpful, especially in nations where there is less access to reputable clinical professionals, there is a need for systems that can support specialized diagnostics. A probable diagnosis is given by the electronic reference-based DDSS DXplain based on clinical symptoms (Martinez-Franco et al., 2018). 87 family medicine residents participated in a randomized control trial, and those assigned to utilize the system demonstrated much superior accuracy (84% vs. 74%) on a validated diagnosis test involving 30 clinical cases.

Given the known prevalence of diagnostic mistakes, especially in primary care, (Singh et al., 2017) there is a great deal of expectation that CDSS and IT solutions can enhance diagnosis (Singh et al., 2014). Currently, diagnostic systems are being created using non-knowledge-based methods like machine learning, which may open the door to more precise diagnosis. The U.K.'s Babylon AI-powered Triage and Diagnostic System is an excellent illustration of the promise of these systems as well as the work that still needs to be done before they are ready for widespread use (Fraser et al., 2018; Razzaki et al., 2018).

## **6. Diagnostics support: imaging**

Information-based imaging commonly used for image ordering, CDSS can help radiologists choose the best test to perform, remind them of best practice recommendations, or warn them to contrast contraindications, for example (Georgiou et al., 2011). Prior to placing an order for an image, the CDSS required that providers respond to a set of questions in order to confirm their



appropriateness. Importantly, the system offered a substitute if an image was rejected.

Non-knowledge based CDSS for improved imaging and precision radiology (also known as “radiomics”) is of tremendous interest (Giardino et al., 2017). Providers need technology to help them with data extraction, visualization, and interpretation because images make up an increasing quantity of medical data but require labor-intensive manual interpretation. Beyond what humans can, Artificial Intelligence (AI) technologies are demonstrating their capacity to offer insights into data (Greenspan et al., 2016). Advanced pixel identification and image classification techniques, most notably deep learning (DL), are used by these technologies to do this (Li et al., 2022; Z. Ye et al., 2023).

Leading businesses like IBM Watson Health, DeepMind, Google, and others are creating products for use in tumor identification, medical image interpretation, diabetic retinopathy diagnosis, Alzheimer’s diagnosis through multimodal feature learning, and a plethora of other applications (Bellemo et al., 2019). In order to provide full decision assistance, or what IBM refers to as a “cognitive assistant,” watsonx® (watsonx.ai and watsonx.data) have been able to merge image identification of a brain scan with text recognition of case descriptions (IBM watsonx, 2023).

## **7. Diagnostics support: laboratory and pathology**

Laboratory testing and interpretation are another area of diagnosis where CDSS might be helpful. A simple and common feature of EHR systems are alerts and reminders for aberrant test results (Eaton et al., 2018). Additionally, CDSS can increase the usefulness of lab-based testing in order to prevent riskier or more invasive diagnostic procedures (Delvaux et al., 2020). Liver biopsies are the gold standard for Hepatitis B and C testing, while non-invasive lab techniques are not reliable enough to be accepted. To achieve considerably higher accuracy, AI models are being created that incorporate numerous tests (serum markers, imaging, and gene tests) (Keltch et al., 2014). When a test’s reference ranges, such as

age, sex, or illness subtypes, are highly tailored, CDSS can also be used as an interpretation tool (Mørkrid et al., 2015).

## **8. Patient-facing decision support**

With the introduction of the Personal Health Record (PHR), CDSS capability is being integrated, much like with EHRs, with the patient serving as the end user or “manager” of the data. This is a fantastic step towards patient-focused care, and CDS-supported PHRs are the perfect instrument to implement shared decision-making between patient and physician. This is because CDSS may eliminate a “lack of information” as a barrier to a patient’s participation in their own treatment (S. Davis et al., 2017). PHRs are typically created as separate web-based or mobile applications, or as an addition to commercial EHR software (Fuji et al., 2012). When PHRs are linked to EHRs, they can have a two-way interaction where information recorded directly by the patient can be made available to their doctors and information in the EHR can be sent to the PHR for patients to view (Tang et al., 2006).

## **D. Hidden Difficulties of CDSS**

### **1. Fragmented workflows**

Workflow for clinicians may be hampered by CDSS, particularly with standalone systems. Many early CDSS were created as systems that required the provider to get information from sources other than their regular workspace or to document information. If CDSS are developed without considering how people interpret information and behave, they might also interrupt workflow. In response, the ‘think-aloud’ design process was used to mimic practitioners’ workflow and produce a more user-friendly solution for CDSS (Kilsdonk et al., 2016).

Workflow disruptions can result in greater cognitive effort, longer task completion times, and less face-to-face time with patients. There may be a gap between in-person contacts and interactions with a computer workstation even when CDSS are fully integrated within current information systems. According to studies,

practitioners who have more practical experience are less likely to employ CDSS and more likely to override it (Araujo et al., 2020; Dowding et al., 2009; B. Ye et al., 2022; Zha et al., 2022).

## **2. Alert fatigue and inappropriate alerts**

According to studies, up to 95% of CDSS alerts are unimportant, and doctors frequently disagree with or mistrust notifications (Ash et al., 2007). Other times, they simply ignore them. Patients and nurses who get too many or unimportant alerts may experience alert fatigue (Khalifa & Zabani, 2016).

Only more significant or consequential contraindications, including severe allergies, should receive disruptive alerts. Nevertheless, even allergy notifications might be wrong, so doctors will frequently check them for accuracy (Légat et al., 2018). Medication alerts can also be specialty-specific, but they become meaningless when taken out of context. For instance, it may not be acceptable to issue a warning against the use of vancomycin or other broad-spectrum antibiotics in an intensive care unit (Ash et al., 2007; Hasan & Yang, 2023). In inflammatory bowel disease clinics, where the same class of medication can be given by many administration methods for greater impact, a warning against duplication of prescriptions may not be relevant (Lorenzo-Zúñiga et al., 2022).

## **3. Impact on user skill**

Healthcare professionals, pharmacists, and nurses were the only ones used to double-check orders prior to CPOE and CDSS. According to Ash et al. (2007), CDSS can provide the appearance that confirming an order's accuracy is either unneeded or automatic. Dispelling this notion is crucial.

A CDSS's potential long-term impact on users must also be taken into account. A CDSS can have a training effect over time, possibly negating the need for the CDSS altogether. The term "carry-over effect" was likely used to describe CDSS that have an educational focus (Gillies & Campbell, 2019). there is a chance that

techniques will be found to assist clinicians in understanding how to use statistical and probabilistic data to more accurately assess risk and to encourage the use of decision support tools into medical decision making for an increase in patient safety (Lai et al., 2006).

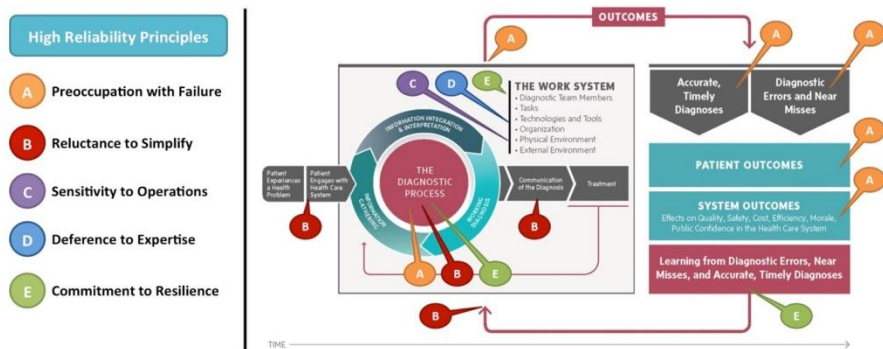


Figure 4.2. Illustrative mapping of high-reliability organizing (HRO) principles to the National Academy of Medicine (NAM) framework (Yousef et al., 2022)

The National Academy of Medicine (NAM) framework has been mapped to high-reliability organizing (HRO) concepts by Yousef et al. (2022). This diagram illustrates how the essential framework proposed by a NAM Committee in 2015 to enhance diagnosis corresponds with the five HRO principles. Despite the fact that all of the HRO principles are generally applicable to the entire framework, some are anticipated to be particularly crucial for resolving the specific difficulties covered in this study. For instance, the preoccupation with failure principle (labeled A) is applicable everywhere but is mapped to the results required to identify failure (and success), the arrow linking the work system to these results, and the diagnostic procedure that results in the results.

#### 4. CDSS may be dependent on computer literacy

Lack of technological know-how can be a barrier to using a CDSS (Devaraj et al., 2014). This can vary depending on the specifics of the CDSS's design, although some have been reported

to be extremely complicated and depend excessively on user expertise (Murray et al., 2011). Systems should make every effort to maintain the pre-existing system's fundamental functionality. In any case, there is a learning curve for new technologies, therefore baseline assessments of user technological proficiency may be helpful. Then, in order to facilitate the full use of CDSS capabilities, further training may be given (Lai et al., 2006), or more specific guidance can be embedded directly into the CDSS recommendations (Ojeleye & Jani, 2016). In order to be unobtrusive, this information could be incorporated as info buttons (Cook et al., 2017).

### **5. System and content maintenance**

The life-cycle of CDSS includes maintenance, which is crucial yet frequently disregarded. This includes doing technical maintenance on the CDSS's supporting systems, programs, and databases. Maintaining the knowledge base and its regulations, which must keep up with the ever evolving nature of clinical guidelines and medical practice, is another difficulty (A.-M. J. W. Scheepers-Hoeks et al., 2011). Even the most cutting-edge healthcare facilities report having trouble keeping their systems up to date as new information is always being discovered. It has been noted that order sets and the computational principles underlying the CDSS are extremely challenging (Ash et al., 2007).

### **6. Operational impact of poor data quality and incorrect content**

Due to the reliance of EHRs and CDSSs on data from external, dynamic systems, there may be new flaws. As an illustration, some CDSS modules might promote ordering even though the hospital is short on supplies. Pneumococcal vaccine inventories or Hemocult tests frequently run out at some hospitals (Catho et al., 2021).

Keeping medication and issue lists up to date and using them properly will help prevent problems. The medicine list may be a list

of dispensations at one location, meaning people may or may not be taking them (and should still be questioned in person). Other drug lists are created solely from CPOE orders, necessitating manual verification that patients are taking the prescribed drugs. Ideal systems would make it simple to identify these. By gathering information on patient medication adherence, PHRs could significantly improve this problem (Catho et al., 2022).

## **7. Lack of transportability and interoperability**

Despite being actively developed for more than three decades, CDSS (and even EHRs in general) have interoperability problems. Numerous CDSS are either bulky standalone systems or part of systems that are unable to efficiently communicate with other systems. The cloud provides a potential remedy for interoperability (as well as other EHR problems like data synchronization, software updates, etc.) (Bresnick & HealthITAnalytics, 2015). Cloud EHRs feature an open architecture, more modern standards, and more adaptable system communication (Fernández-Cardenosa et al., 2012). Another widespread misperception is that cloud storage makes data more exposed. It's possible that this is false. Data must be kept in high-security facilities with cutting-edge encryption and other security measures for web-based EHRs.

National data security regulations must be followed, such as the General Data Protection Regulation (GDPR) in Europe, the Health Insurance Portability and Accountability Act (HIPAA) in the United States, and the Personal Information Protection and Electronic Documents Act (PIPEDA) in Canada, to name a few. They have the same potential for safety (or vulnerability) as conventional server-based design. In contrast to server-based records, there are frequently fewer users who have access to unencrypted data in cloud storage facilities (Rodrigues et al., 2013).

## **8. Financial challenges**

A CDSS user's capacity to maintain financial sustainability was cited as a challenge by up to 74% of respondents (Kabachinski, 2013). It might be expensive up front to install and integrate new technology. Since new employees must be educated to utilize the system and because system updates are necessary to keep up with advancements in knowledge, ongoing expenditures may always be a problem.

Cost evaluations of CDSS systems have produced inconsistent, polarizing, and scantily documented results (Bright et al., 2012; Jacob et al., 2017; O'Reilly et al., 2012). There are several variables that can affect an intervention's cost-effectiveness, including those that are unique to the political and technological environments (O'Reilly et al., 2012). Inadequate standardized measurements are just one of the difficulties that limit cost-benefit analysis in and of itself (Jacob et al., 2017). It will take a lot of effort to increase our knowledge of the financial consequences of CDSS because this is a new field of study.

## **E. Clinical and Nursing Decision Making Process and Implementation**

The clinical decision support system (CDSS) aids in decision-making by utilizing communication and information technologies in connection with medical research and patient-related disorders. By using intellectual decision-making rules at the appropriate point, it gives patients and clinicians information and clinical expertise to improve patient care (Gholamzadeh et al., 2023). Typically, CDSS objectives entail outlining a clinical procedure or job. Decision-making models that assess decisions are CDSS components. The host application and the application setting that transmits, gathers data having interaction with the application organize data and knowledge for data calculation, information model used in deduction, knowledge foundation function, and decision making model results (Chung et al., 2016). The main tasks carried out by CDSS include functions that support decision-making, regulate

costs, manage clinical complexity and detail levels, and perform management and administrative tasks. The use of palliative care CDSSs has been shown to help nurses and other clinicians deliver better care to people with the disease (Santos et al., 2023).

There is a decision-support system for managing high blood pressure in clinics, a widespread high blood pressure management system that uses CDSS by the Catholic U-health care business group, a half-automated blood sugar management system that uses CDSS, an internet-based glucose monitoring system, a system for improving lifestyle that is tailored to people at high risk of developing chronic diseases, and a system for providing customized information to people with health insurance using clinical decision support system’s workflow is depicted in Figure 4.3.

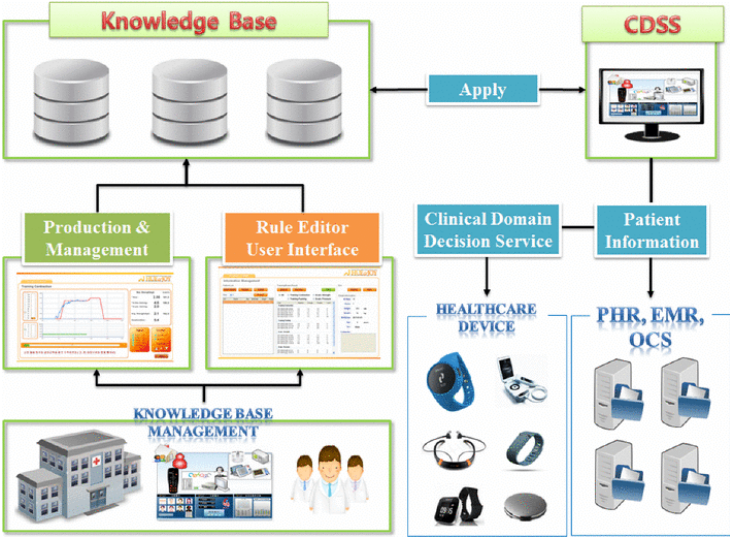


Figure 4.3. Process of Clinical Decision Support System (Jung & Chung, 2016)

Other experiences from Norway that primary objective of the Individualized Digital Decision Assist System (IDDEAS) is to create a CDSS that will support the clinician in making clinical decisions in order to enhance the outcomes for children and adolescents’ mental



health. By giving physicians data-driven and evidence-based assistance in real time, IDDEAS explicitly aims to improve care by promoting earlier and more accurate decision-making, avoiding misdiagnosis and ineffective care practices, and enhancing tailored treatment management. For data-driven support, IDDEAS will also make use of Norway’s distinctive and existing resources, including the child and adolescent mental health services (CAMHS) databases and other health datasets, in addition to the country’s clinical treatment pathways and guidelines (Clausen et al., 2021).

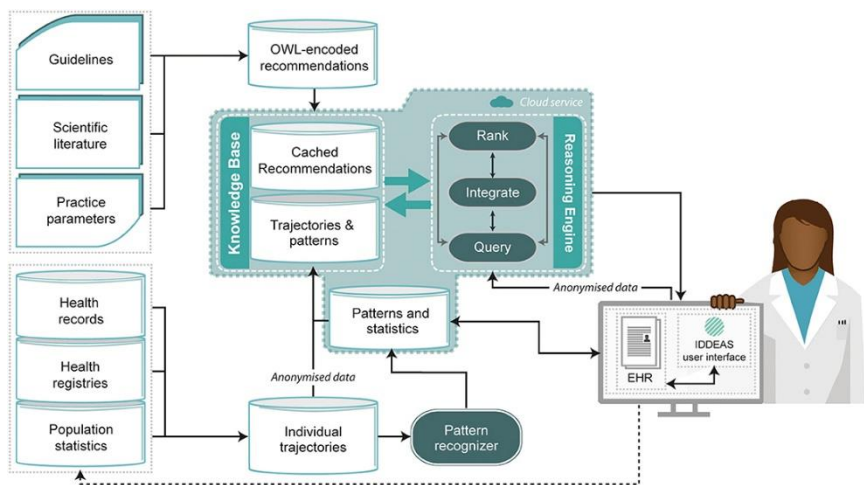


Figure 4.4. The Individualized Digital DEcision Assist System (IDDEAS) clinical decision support system model (Clausen et al., 2020)

IDDEAS’ primary objective is to create a clinical decision support system (CDSS) that will support clinicians in making better clinical decisions, ultimately leading to better mental health outcomes for kids and teenagers. IDDEAS especially aims to enhance care by giving clinicians data-driven and evidence-based assistance in real-time, ensuring earlier and more accurate decision-making, avoiding misdiagnosis and ineffective care practices, and enhancing tailored treatment management. CAMHS datasets and other health datasets are among the unique and

current resources available in Norway that IDDEAS will make use of in addition to the Norwegian CAMHS guidelines and clinical care pathways to offer data-driven support (Røst et al., 2020).

Following are some CDSS application interfaces for Lifestyle improvement mobile services for high-risk chronic diseases based on the personal health records (PHR) platform reported by Jung & Chung (2016):

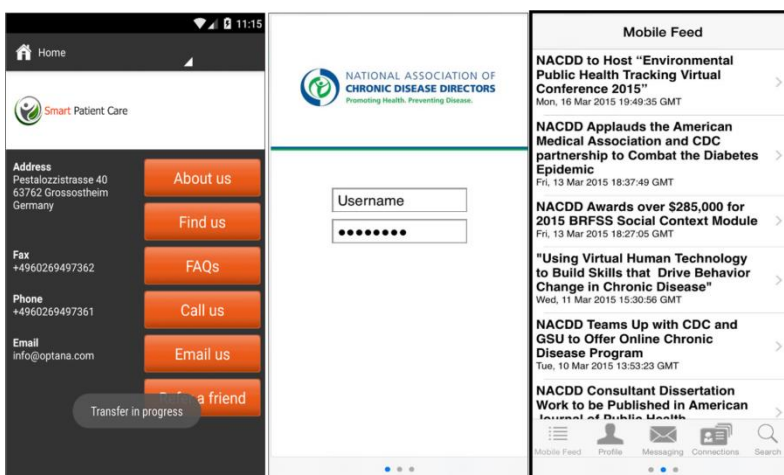


Figure 4.5. Previous health management service of chronic diseases for elders

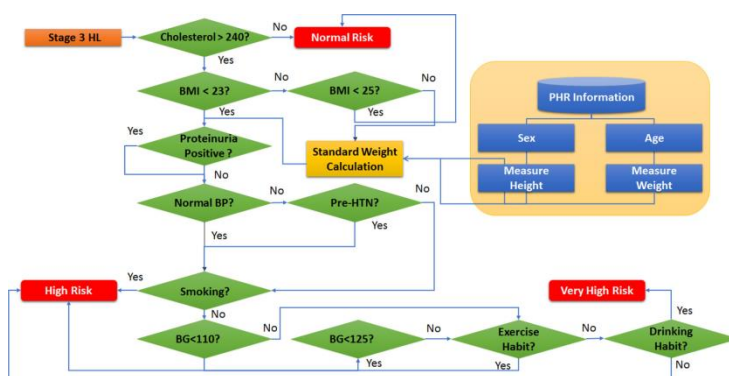


Figure 4.6. High blood pressure disease basis process in PHR platform

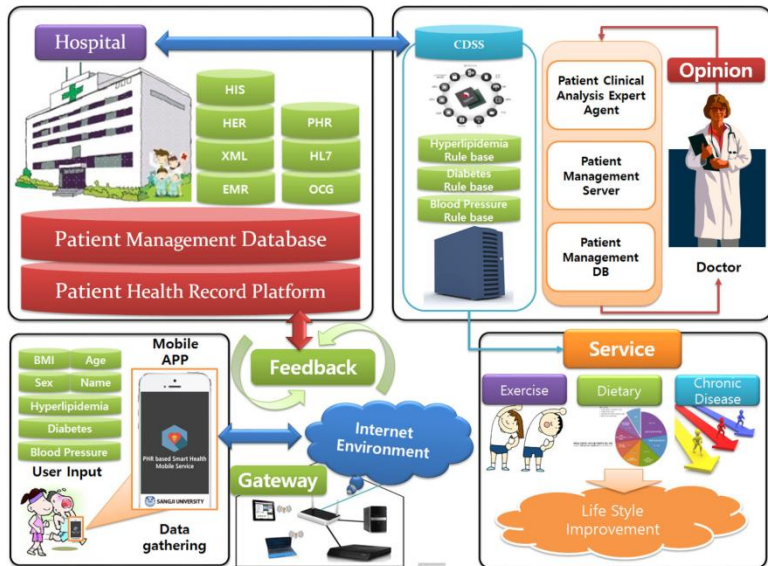


Figure 4.7. Service environment in PHR platform

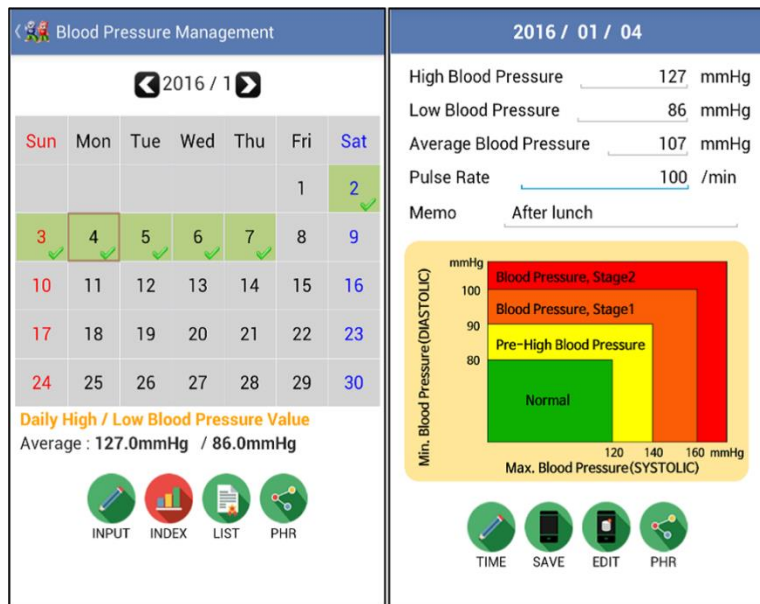


Figure 4.8. Interface of blood pressure input for disease management of high blood pressure

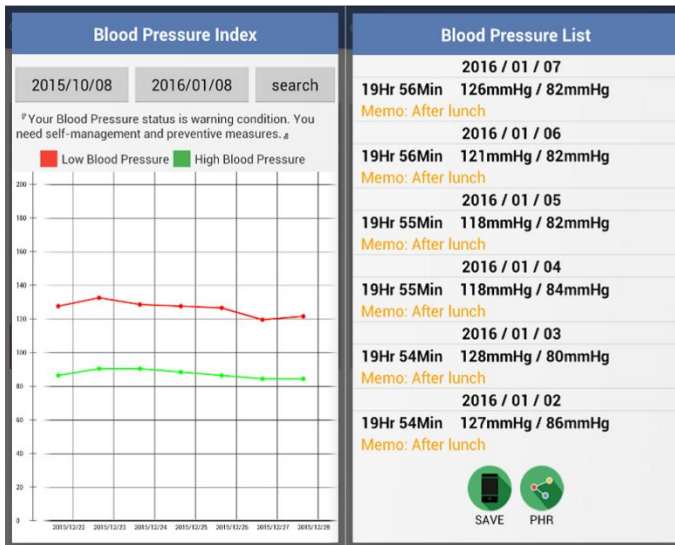


Figure 4.9. Graph and list of blood pressure change for high blood pressure management

## F. High-Reliability Organizing (HRO)

High-reliability organizations (HROs) align their everyday operations and procedures with five fundamental principles in order to promote safe and dependable performance and a consistent state of corporate mindfulness. (Goldenhar et al., 2013; Vogus & Hilligoss, 2016).

1. **A preoccupation with failure**, when everyone is consciously on guard, vigilant, and conscious of their goals and the possibility of failure.
2. **Reluctance to Simplify**, in which individuals challenge presumptions and resist tendencies to simplify or minimize their understanding of the circumstances they encounter, particularly problems and challenges; rather, these are viewed as opportunities to learn and improve their comprehension of work processes, how things succeed or fail in their environment, and why.

3. Sensitivity to Operations is the process by which organizational members create a comprehensive picture of the state of affairs through ongoing real-time information in order to prevent tiny problems from multiplying and expanding as well as to stop problems from spreading to other areas.
4. Deference to Expertise, which acknowledges that knowledge and hierarchical power are not comparable; rather, there is an understanding that those who are most closely associated with the task are frequently the ones who know it best. In order to ensure that decision-making authority can move when necessary to the person or people with the highest competence, deference to experts necessitates flexible decision structures.
5. Commitment to resilience is the outcome of expanding one's action repertoire and improvisational skills so that one can quickly react to failures or mistakes, learn from them, and adapt (Vogus & Sutcliffe, 2007a).

Even in the riskiest circumstances, HROs are able to attain and maintain outstanding levels of safety thanks to collective consciousness, flexibility, and learning. In order to counteract tendencies to categorize events into familiar categories, strengthen the ability to anomalize events, and enhance abilities to deal more wisely with what is seen, mindfulness—enhanced awareness of discriminatory contextual details that makes situations more meaningful and facilitates contingent responsiveness—must be practiced (Vogus & Sutcliffe, 2007b).

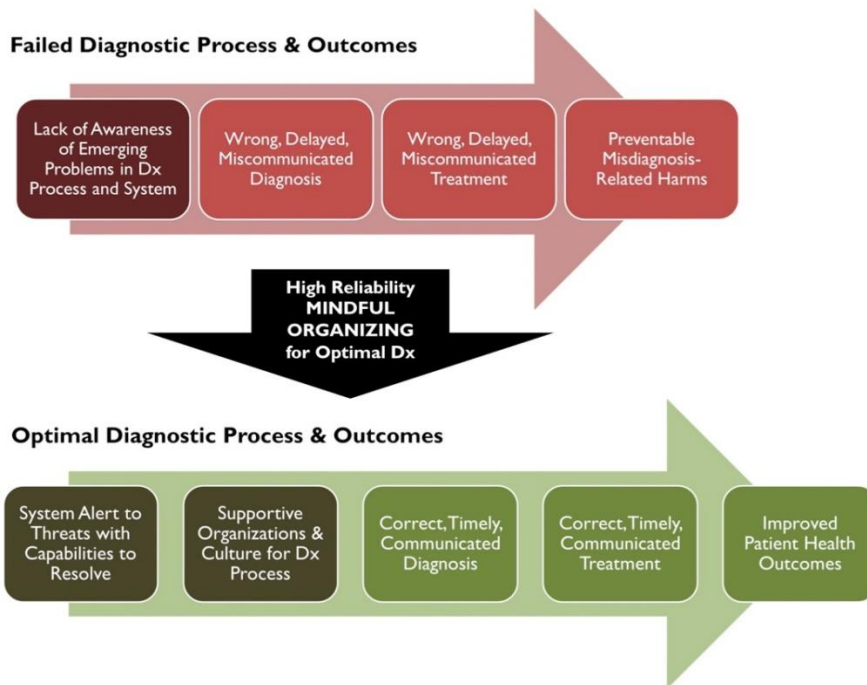


Figure 4.10. The promise of high-reliability organizing (HRO). This diagram depicts the fundamental transformation from a failed diagnostic process to an ideal one through mindful application of HRO principles (Yousef et al., 2022)

The HRO paradigm offers methods for managing a range of complicated, risky technologies, therefore in theory, HRO principles ought to apply to the diagnostic procedure. Although there are many commonalities in techniques across industries, there are also differences based on regional contexts and unique technical challenges.

Yousef et al. (2022) identify and explain particular aspects of the diagnostic process and the circumstances in which it takes place that may provide challenges to (and possibly even thwart) attempts to apply HRO organizational concepts to diagnosis in clinical practice. As seen in Figures 4.2, implementing the five HRO principles and an HRO paradigm of mindful organizing has the

promise of transforming a potentially dangerous lack of awareness into organizational support for an improved diagnostic process and ensuing outcomes.

## **G. CDSS Five Rights Framework**

Every person involved in the quality improvement (QI) effort should have a common recognize of essential concepts (e.g., CDSS), frameworks (e.g., CDSS 5 Rights Framework), strategies (e.g., the QI process), tools (e.g., Essential CDS/QI Worksheet), and QI project success elements, such as the CDSS, the QI process, and the CDSS 5 Rights Framework.

### **1. Clinical Decision Support System**

Clinical Decision Support System is a key underpinning for the QI approach outlined in this Guide, but its meaning here might be different than what you have in mind (especially if ‘alert’ figures prominently in your definition). CDSS is defined as a process for improving health-related decisions and actions with pertinent knowledge and patient information to enhance health and care delivery. Under this definition, CDSS is about supporting care decisions and actions, ideally in a manner that makes the appropriate decisions and actions the easy ones to execute. That is, facilitating workflow not interrupting it – as alerts often do. There are many different ways to provide this support (e.g., CDSS intervention types).

For fully achieving CDS’s promise, the Roadmap identifies three pillars:

- a. Best Knowledge Available When Needed: widely accessible, and written, stored, and transferred in a way that facilitates the development and deployment of CDSS interventions that incorporate the knowledge into the decision-making process.
- b. High Adoption and Effective Use: CDSS tools are substantially used, broadly implemented, and offer significant clinical benefit while making sense financially and operationally for their end users and buyers.

- c. Continuous Improvement of Knowledge and CDSS Methods: Based on feedback, experience, and data that are simple to compile, evaluate, and implement, both CDSS interventions and clinical knowledge are continuously improved.

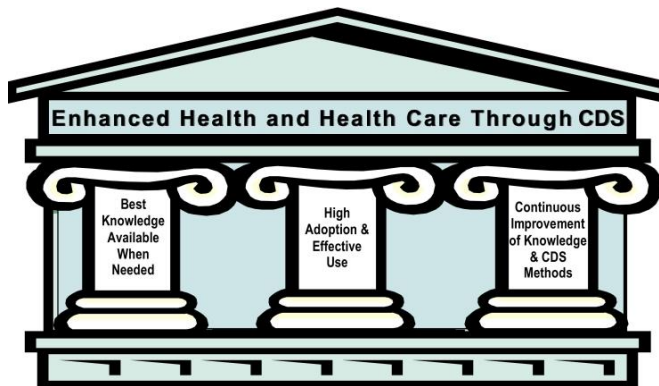


Figure 4.11. The three pillars for realizing the promise of Clinical Decision Support (CDS) (J. A. Osheroff et al., 2007)

## 2. CDSS 5 Rights Framework

The CDSS 5 Rights concept and approach was first articulated by (J. A. Osheroff et al., 2007) in 2006. Understanding and leveraging effectively these 'what, who, how, where, when' information flow dimensions is central to configuring useful CDS/QI approaches. The CDSS 5 Rights framework is a best practice QI approach (recommended by CMS in the tipsheet above) to support decisions and actions that drive performance targeted for improvement. It asserts that optimizing care processes and outcomes requires getting the right information to the right people in the right formats through the right channels at the right times (see figure below). The tools and approaches outlined in this Guide help organizations implement this framework and enhance the contributions, experience and results for those involved in care delivery.

In 2006, J. A. Osheroff et al. (2007) introduced the CDSS 5 Rights idea and methodology. The key to constructing efficient



CDS/QI techniques is comprehending and utilizing these “what, who, how, where, when” information flow characteristics. The US Centers for Medicare & Medicaid Services (CMS) tipsheet above suggests the CDSS 5 Rights framework as a best practice QI approach to support decisions and actions that drive performance that is intended to be improved (Greenes et al., 2018). It contends that maximizing care procedures and results necessitates delivering the appropriate information to the appropriate individuals in the appropriate formats via the appropriate channels at the appropriate times (see Figure 4.12). Organizations can use this framework and improve the contributions, results, and experiences of those involved in care delivery using the tools and strategies (Sutton et al., 2020).

**a. The Right Information**

Evidence-based, generated from a set of accepted guidelines, or based on a national performance metric should all be used to support the information provided to the end-user—or in certain situations, the patient. An alert is sent to the doctor telling them that the elderly colonoscopy patient needs to be checked for colon cancer (Lorenzo-Zúñiga et al., 2022). The warning is based on the US National Committee for Quality Assurance’s NQF-0034 (Colorectal Cancer Screening), a national performance indicator. Additionally, the American Cancer Society published a series of recommendations that specify who from the general population should have routine colonoscopies for the detection of colon cancer (US National Committee for Quality Assurance, 2022).

Only the information required for the end user to take action should be included in the intervention, in this case an alert. A cognitive overload that results from receiving too much information may cause the end user to ignore the alarm. In the present case, the doctor is informed that the patient is within the age range—patients 50 to 75—who should be examined for colon cancer and that they have a family history of the disease. The channel (EHR) used to send the alert should

make this information accessible via a URL or portable document format file in cases where the doctor wishes to read the performance measure or the recommendations on which the alert is based. The physician urges the patient to undergo a colonoscopy due to the alert and optimizing adjuvant chemotherapy for colorectal cancers (Kleppe et al., 2022). Some experts advise against basing interventions only on expert opinion for healthcare organizations and practitioners who are still developing CDSS interventions. Expert judgment can be disputed in various situations. It may have a negative impact on whether a user complies with the suggested actions constituting the basis of the CDSS intervention because it may not be accepted as best practice by all.

**QI SUCCESS FRAMEWORK: CDS FIVE 'RIGHTS'**  
**TO IMPROVE TARGETED CARE PROCESSES/OUTCOMES, GET...**

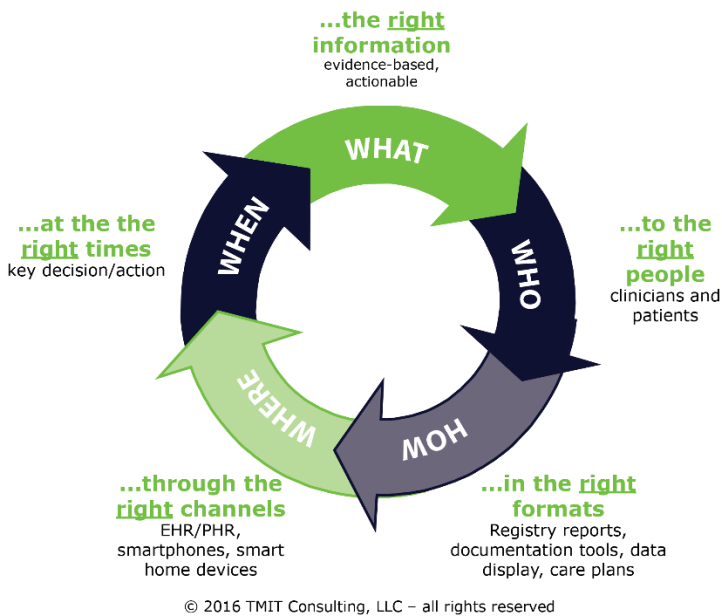


Figure 4.12. Quality Improvement Success Framework using Clinical Decision Support FIVE 'RIGHT' (HITEQ Center, 2023)

### **b. The Right People**

Making sure the proper information reaches the appropriate person who can subsequently take action is crucial as healthcare adopts a more team-based approach. A nurse, doctor, physical therapist, or even a partner in some circumstances, can be the ideal individual (Campbell, 2013). In the aforementioned illustration, the appropriate party is the doctor who receives the warning and suggests the patient get a colonoscopy. It's crucial to remember, nevertheless, that CDSS interventions can occasionally alter the duties of the care team. For instance, if the patient is unwilling to follow medical advice, a significant other or sibling who is skilled in persuasion would be the best person to provide the information—in the form of an alert—to the patient. The key lesson here is to only share information with those who can act on it. An example where a nurse is given instructions to change a patient's medication dosage is frequently used in the literature on health informatics. The nurse has no means of knowing whether the drug dosage has already been changed, thus this kind of information is problematic.

### **c. The Right Intervention Format**

As was previously said, there are numerous ways to apply CDSS, including alerts, order sets, protocols, patient monitoring systems, and info buttons. Because of this, it is critical for implementers to recognize the problems and challenges they are attempting to address and to select the most appropriate format for doing so. Additionally, when creating a CDSS program, implementers should make a list of existing systems to identify which CDSS tools are accessible, which tools must be created internally, and which products must be obtained from a vendor. A practice wants to identify patients who are at risk for serious illnesses and persuade them to take preventive action, as in the first case. A non-intrusive alarm that alerts the doctor of a patient's propensity

for a disease—in this case, colon cancer—is the most straightforward option.

**d. The Right Channel**

The delivery of CDSS interventions in the healthcare industry can be done via an EHR, PHR, computerized physician order input, a smartphone app, and—if required—in paper form via flow-sheets, forms, and labels. If the doctor in the aforementioned scenario is the appropriate individual, the EHR might be the best platform for sending the alert. A text messaging program operating on a smartphone, however, can be the best platform if a significant other is the proper person. The alert would notify the recipient that the patient required a colonoscopy.

**e. The Right Time in Workflow**

A major issue in health information management is the desire to integrate new technology into existing clinical workflows. A drawback of this method is that information might reach a physician at an inopportune moment or might not be there when it's needed. Colonoscopy data set, surgery data set, pathology data set, genetics data set, and pedigree data set were the five categories that made up the screening minimum data set for the national colorectal cancer screening program. Information gaps and deficiencies were examined. Then the team created a uniform work process for screening. Finally, the entrance stage and DSS workflow were established (Maserat et al., 2015).

A CDSS plays a critical role in developing the best interactions between the departments of pathology, laboratory, and colonoscopy. It facilitates complex decision-making for screening. Additionally, workflow analysis can be used to pinpoint data reconciliation techniques for filling up documentation gaps. The quality of colorectal cancer screening should be improved by implementing CDSS guidelines (Maserat et al., 2015; Winawer et al., 2011).

**f. Essential CDS/QI Worksheet**

The Essential CDS/QI Worksheet works best for early attempts to map care processes and identify areas for improvement. Specifically, to capture, examine, and brainstorm potential improvements to target-focused information flows and workflows.

**g. Quality Improvement Process**

Focus on People, Process, and Technology (in that order) as the major QI project success criteria. Recognize that engaging all parties is essential for success.



Figure 4.13. Clinical Decision Support FIVE ‘RIGHT’ for Care Transformation (HITEQ Center, 2023)

**h. Key Quality Improvement Project Success Factors**

When choosing improvement targets, chances to improve care processes for the target, and activities to assure successful implementation of such process improvements, pay attention to “the most important things.”



Figure 4.14. Key Quality Improvement Project Success Factors (HITEQ Center, 2023)



### Exercise

Explain the next task with your own perspectives for better understanding about digital transformation.



### Summary

CDSS have been shown to augment healthcare providers in a variety of decisions and patient care tasks, and today they actively and ubiquitously support delivery of quality care. Some applications of CDSS have more evidence behind them, especially those based on CPOE. Support for CDSS continues to mount in the age of the electronic medical record, and there are still more advances to be

made including interoperability, speed and ease of deployment, and affordability. At the same time, we must stay vigilant for potential downfalls of CDSS, which range from simply not working and wasting resources, to fatiguing providers and compromising quality of patient care. Extra precautions and conscientious design must be taken when building, implementing, and maintaining CDSS. A portion of these considerations were covered in this review, but further review will be required in practice, especially as CDSS continue to evolve in complexity through advances in AI, interoperability, and new sources of data.



Choose the correct answer:

1. How are CDSS used in medication management in nursing?
  - A. CDSS are used in medication management in nursing to play music for patients
  - B. CDSS are used in medication management in nursing to provide decision support for prescribing, administering, and monitoring medications, as well as to reduce medication errors and improve patient safety
  - C. CDSS are used in medication management in nursing to provide entertainment for nurses
  - D. CDSS are used in medication management in nursing to organize medical supplies
  
2. What is the role of CDSS in the integration of electronic health records in nursing?
  - A. CDSS is used for scheduling appointments in nursing
  - B. CDSS is responsible for maintaining hospital equipment in nursing

- C. CDSS helps in providing clinical decision support to nurses by integrating electronic health records, which can improve patient care and safety
  - D. CDSS is used for billing and insurance purposes in nursing
3. What is the impact of CDSS on patient outcomes in nursing practice?
- A. CDSS has been shown to improve patient outcomes in nursing practice by providing evidence-based recommendations, reducing medication errors, and enhancing clinical decision-making
  - B. CDSS only improves administrative tasks in nursing practice, not patient outcomes
  - C. CDSS has a negative impact on patient outcomes in nursing practice
  - D. CDSS has no impact on patient outcomes in nursing practice
4. What are the main challenges in implementing CDSS in nursing?
- A. Minimal training and support for users
  - B. Some main challenges in implementing CDSS in nursing include resistance to change, lack of integration with existing systems, data privacy concerns, and the need for extensive training and support for users
  - C. Lack of interest in technology
  - D. Smooth integration with existing systems
5. What are the ethical considerations in the utilization of CDSS in nursing?
- A. Informed consent is not necessary when using CDSS in nursing
  - B. CDSS in nursing does not require patient privacy and confidentiality



- C. The ethical considerations in CDSS are irrelevant in nursing
- D. Some ethical considerations in the utilization of CDSS in nursing include patient privacy and confidentiality, data security, informed consent, and the potential for bias in decision-making

Check your answers with the answer key on the formative test at the end of this module. Count the correct answers. Then, use the following formula to determine your mastery level of module 1 material.

$$\text{Level of Mastery} = \frac{\text{number of correct answers}}{\text{number of questions}} \times 100$$

The meaning of the level of mastery:



If you reach 80% or more mastery, you can continue with Learning Activity 2. Good! If you are still below 80%, you must repeat the material for learning activity 1, especially the parts you haven't mastered yet.

Keys:

- 1. B
- 2. C
- 3. A
- 4. B
- 5. D

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## UNIT V

# HEALTH INFORMATION SYSTEM EVALUATION

### **Learning Objectives:**

After taking this chapter, you'll be able to:

1. Explain the health information system strengthening
2. Explain the digital maturity assessment in health facilities
3. Explain the other health information system evaluation models
  - a. Technology Acceptance (TAM) Model
  - b. End User Computing (EUC) Satisfaction
  - c. Task Technology Fit (TTF) Analysis
  - d. Human-Organization-Technology (HOT) Fit Model

### **A. Introduction**

Information systems are implemented in social systems such as organizations in which different kinds of people and environments interact with each other. In information systems studies, the fit between the people, environment, organization, and technology itself, has been studied by many researchers. Various fit concepts have been studied and developed by various studies and have become a reference for research in the field of information systems.

Experts have created a variety of tools for evaluating health information systems, but some of the most well-known ones are the Technology Acceptance Model (TAM), End User Computing (EUC) Satisfaction, Task Technology Fit (TTF) Analysis, and Human-



Organization-Technology (HOT) Fit Model. The ideas that underpin the aforementioned four models are covered in this chapter.

## **B. Health Information System Strengthening**

The Republic of Indonesia's Minister of Health issued Regulation No. 21 of 2020, which calls for changes to the governance of health development, including integrating information systems, research, and health development. By introducing the 2024 Indonesia Health Digital Transformation blueprint, the Ministry of Health of the Republic of Indonesia aims to achieve its health development goals. This program is carried out for the purpose of providing helpful information to support decision-making in implementing the Health program. The goal of Indonesia's digital health revolution is to build human resources (HR) capable of analyzing medical data. Every health agency is expected to establish a data-based policy as a result.

The goal of the Health Digital Transformation Strategy 2024 is to build a healthy Indonesia in partnership with the full ecosystem of the healthcare sector through the Indonesia Health Services (IHS) Platform. The IHS platform is a digital health ecosystem platform that gives Indonesians access to data connection, analysis, and services to support and integrate different health applications (Kurniawan & Novi Sulistia Wati, 2021). The IHS platform is built on six main principles:

1. Platforms that use services. National health data is derived from the delivery of health services, where data is produced in accordance with the delivery of health services rather than being developed through periodic reporting that is aggregate in nature, which has a tendency to add to administrative burdens and does not provide an adequate level of data depth for further analysis.
2. Architecture and specification standardization. Instead of standardizing it into an out-of-date application, the HIS Platform aims to harmonize architecture and data interchange requirements among stakeholders in the healthcare sector.

3. The ecology of the health business works together. All participants in the health business will use the HIS platform, which is not intended to replace current systems or applications.
4. OpenAPI (Application Programming Interface) based on microservices. The HIS platform provides data exchange services that can be used openly by all healthcare industry players.
5. Compliance through integration. The HIS platform is a means for the Ministry of Health to monitor compliance with data requirements and fulfillment of minimum service standards for all health industry players through integrated transaction activities.
6. Mutual benefits through service convenience and integrated information. The HIS platform provides benefits for the entire ecosystem of health industry players who are members of it, in the form of data processed by big data analytics and integrated information.

The national health information system has 7 (seven) interconnected and interrelated components, namely: manual data sources, computerized data sources, health service information systems, stakeholder information systems, national health data banks, data users by the ministry of health and data users. The rapid development of information and communication technology is an opportunity that can provide convenience in strengthening and developing health information systems. Currently, the need to utilize information and communication technology in health information systems is increasing in line with efforts to improve the quality, efficiency and effectiveness of the management and implementation of health development, especially in health services. Therefore, health information system planning must also make optimal use of developments in information and communication technology in the implementation of health information systems broadly (Adhani et al., 2022).

Health technology transformation including information systems has actually been included in one of the strategies to carry out Ministry of Health policies until 2024. Health technology transformation leads to digitalization of health and wider use of technology in the health sector, namely with capacity specifications:

1. An integrated health data system, namely a system with a single health data governance architecture, part of a big data system based on a single health identity, and having a health analysis system based on artificial intelligence/AI (Artificial Intelligence) and with an expanded scope of single-health identity.
2. An integrated health application system, namely with a health system interoperability architecture, having an integrated health service facilitation information system and having an expanded coverage of integrated health service facility information systems.
3. It is a health technology ecosystem, namely with health information system security assessment features, expansion of telemedicine supporting infrastructure, implementation of artificial intelligence-based regulatory sandboxes, blockchain and internet of things (IOT), as well as expansion of health technology innovation licensing.

### **C. Digital Maturity Assessment in Health Facilities**

Often policy makers in the health sector experience difficulties in making appropriate decisions due to limited or unavailability of accurate, precise and fast data and information. Data and information are very strategic resources in the management of health development, namely in the process of management, decision making, governance, and implementation of accountability. Therefore, in Article 345 of Law Number 17 of 2023 it is stated that in order to carry out effective and efficient health efforts, health information is needed. The intended health information is carried out through an information system and through cross-sectors and must be integrated with the National Health Information System. In

addition, in an effort to improve public health status, the Government provides facilities for the public to obtain access to health information.

Health information is defined as health data or information that has been processed or processed into a form that contains value and meaning that is useful for increasing knowledge in supporting health development. This data and information then become a reference in the process of management, decision making, planning and accountability.

The Ministry of Health of the Republic of Indonesia has issued Regulation of the Minister of Health of the Republic of Indonesia Number 18 of 2022 concerning Implementation of One Data in the Health Sector through the Health Information System. This policy aims to produce data that is accurate, up-to-date, integrated and accountable, as well as easily accessible and shared between central agencies and regional agencies through compliance with data standards, metadata, data interoperability, and using reference codes and master data.

One of the instruments for evaluating the capacity of health information systems is the use of the Digital Maturity Assessment instrument in Health Facilities. This assessment uses the Health Metric Network (HMN) instrument recommended by the World Health Organization (WHO) and was introduced in 2005. The HMN itself is a framework that contains standard references for developing health information systems by assessing the implementation of health information systems through 6 (six) steps aspect (Health Metrics Network, 2008), i.e.:

1. The resources used in preparing the Health Information System
2. Indicators
3. Data sources
4. Data management
5. Data quality
6. Dissemination and utilization.

## **D. Other Health Information System Evaluation Models**

### **1. Technology Acceptance (TAM) Model**

Several theoretical models have been put forth over the past 30 years to evaluate and explain adoption and behaviors related to the introduction of ICT. Strong metrics have been created to assess how well a technology “fits” with user tasks, and these task-technology fit instruments have been verified (Coiera, 2015). The most well-known of these is the technology acceptance model (TAM), which was first introduced in 1989 (F. D. Davis, 1989) and has since been used and empirically verified in a wide range of ICT application areas (Yarbrough & Smith, 2007; Yousafzai et al., 2007).

The TAM is also one of the most often used research models to forecast individual users’ use of information systems and technology as well as their intention to engage in specific behaviors (Nadri et al., 2018; Surendran, 2012). The TAM was originally derived from the social psychological theories of reasonable action (TRA) and planned behavior (TPB), (Holden & Karsh, 2010) These three models all center on a person’s intention to perform the behavior, (Dillard & Pfau, 2002) but the constructs of these three models are different and not exactly the same. The fundamental model presupposes that perceived usefulness (PU) and simplicity of use play a mediating role in the relationship between system attributes (external variables) and system usage (Legris et al., 2003). The fundamental model presupposes that perceived usefulness and simplicity of use play a mediating role in the relationship between system attributes (external variables) and system usage. (as shown in Fig. 5.1) (F. D. Davis et al., 1989). There have been numerous assessments of TAM usage across the entire ICT area. In 2003, Lee et al (Y. Lee et al., 2003) and Legris et al. (Legris et al., 2003) provided accounts of the first ten years of TAM-related research and suggested future initiatives.

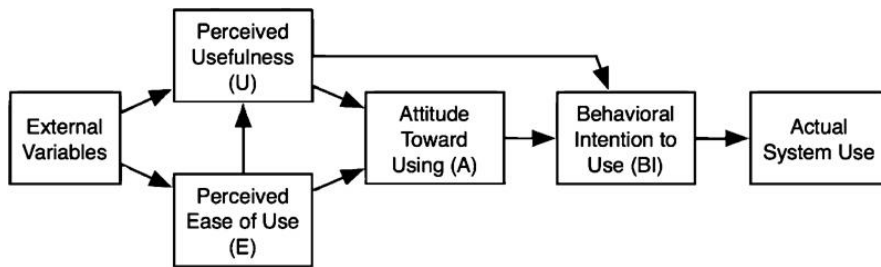


Figure 5.1. The basic technology acceptance model (F. D. Davis, 1989)

The directives said that it was necessary to investigate boundary conditions and incorporate more variables relevant to human and social change processes. The “Attitudes” concept had already been eliminated, and the “External variables” concept had been divided into social influence (subjective norm, voluntariness, and image), cognitive instrumental processes (job relevance, output quality, and result demonstrability), and experience at that time (Venkatesh & Davis, 2000). A few years later, Sharp (Sharp, 2007) focused attention to the contrasts between voluntary and required usage environments while continuing to analyze the relative strengths of perceived usefulness and perceived easiness, as well as the impact of attitudes in user acceptability.

Based on analyses of eight well-known models, including the TAM, Venkatesh et al. presented a unified model, the unified theory of acceptance and use of technology (UTAUT). The UTAUT is designed with four main factors that affect intentions and use: performance expectations, effort expectations, social influence, and facilitating conditions. It also includes four moderators of significant relationships: gender, age, experience, and voluntariness of use (Venkatesh & Davis, 2000). The same year, King and Jun conducted a statistical meta-analysis of TAM applications in various fields, reporting the TAM to be a valid and robust model that has been widely used (King & He, 2006). In 2008, the TAM was extended with regard to determinants of perceived ease of use

(PEOU) (Venkatesh & Bala, 2008). The TAM is composed of four constructs: PEOU, PU, behavior intention, and use behavior.

Turner et al came to the conclusion that caution should be exercised when utilizing a specific version of the TAM outside the context in which the version was initially validated after focusing on use environments rather than theory creation (Turner et al., 2010). Hsiao and Yang conducted cocitation analysis to determine the following three key application contexts for TAM use before continuing with the assessments of model validity across use environments: (1) task-related systems, (2) e-commerce systems, and (3) “experiential” (or “hedonic”) systems (Hsiao & Yang, 2011). Systems that are related to tasks are made to increase task performance and effectiveness. These systems fall under the categories of office systems, software development, automation software, and communication systems like the electronic health record (EHR). The EHR may include clinical practice recommendations, related teaching material, and patient handouts. This may enable a medical question to be answered while the patient is still in the examination room (Hoyt & Yoshihashi, 2014). E-Commerce is the activity of buying or selling of products on online services or over the Internet (Turban et al., 2004). The “hedonic” information systems are usually connected to home and leisure activities, focusing on the fun or novel aspect of information systems includes online gaming, online surfing, online shopping, and even online learning while perusing enjoyment at the same time (Hsiao & Yang, 2011).

A systematic review was carried out in 2010 by Gagnon et al. to look into the variables affecting health care workers’ adoption of ICT. The two most important elements in this review, which covered all ICT acceptance models in health services, were determined to be PU of system and PEOU (Gagnon et al., 2012). The original TAM’s two key elements are these two things (Nadri et al., 2018). A modified TAM with variables describing the health service context and user groups added could provide a better explanation of nurses’ acceptance of health care technology, according to

Strudwick's analysis of TAM applications among nursing practitioners with regard to applications in particular health services areas (Strudwick, 2015). The TAM is one of the best models for examining patients' perceptions and behaviors, according to Ahlan and Isma'eel's assessment of patient acceptance of ICT (Ahlan & Ahmad, 2015). Additionally, Garavand et al. found that the TAM is the most significant model for identifying the elements impacting the adoption of information technology in the health system in their general evaluation of the most popular acceptance models in health care (Garavand et al., 2016).

Between 1999 and 2017, telemedicine applications were the ICT application field that the TAM was used to study most frequently. This indicates that throughout this time, employing ICT to construct health service organizations presented a significant challenge due to public acceptance of the technology. Since the bulk of the articles under examination discussed modifications to the original TAM, it is likely that no single version of the TAM is best for use in healthcare. There are still areas that can be broadened and enhanced in order to boost the TAM's predictive performance, even though the review findings show a continual improvement (Rahimi et al., 2018).

## **2. End User Computing (EUC) Satisfaction**

The use of information technology (IT) is becoming more and more prevalent in Greek public hospitals and the healthcare industry as a whole. It is well acknowledged that using IT in hospitals presents enormous growth prospects and opportunities, particularly in terms of enhancing patient care quality, elevating staff performance, and significantly lowering operating costs (Bates et al., 2001). Despite the fact that implementing and expanding the use of IT in hospitals is becoming more expensive, the outcomes of these investments have not been fully investigated (Loo & P, 1995). Individual studies have found a link between the amount of IS/IT investment and the productivity of healthcare services (Menon et



al., 2000), but overall findings from studies on the profitability of IT investment have been mixed (Mitra & Chaya, 1996).

However, the efficiency of a single hospital information system is not assured by the efficiency of IT investments. A thorough assessment of the systems used in hospitals is therefore advised, and the findings may have significant implications for both the decision-makers in place today and information system users in the future (Holden & Karsh, 2010; Rigby, 2001). Many different approaches have been developed for the evaluation of information systems, each one having its own unique characteristics. However, no one approach is considered as complete and generally applied for the evaluation of HIS (Ammenwerth et al., 2003; Rigby, 2001) as is characteristically observed by Bokhari (Bokhari, 2005), “the evaluation of an informational system in terms of success, is a complicated phenomenon by its nature” (p. 211).

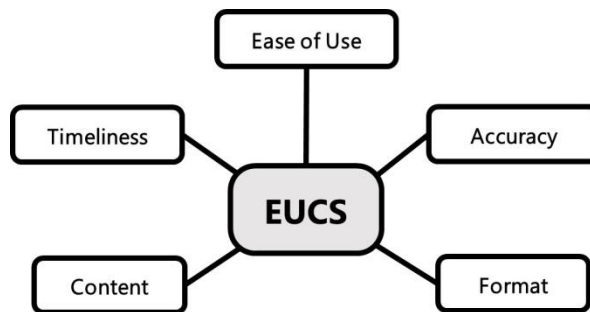


Figure 5.2. End-User Computing Satisfaction (EUCS) Model (Padalia & Natsir, 2022)

The following is an explanation of each dimension as measured by the End User Computing Satisfaction method according to (W. Chin & Lee, 2000):

**a. Content Dimensions**

A system’s contents are measured by the content dimension of user satisfaction. The system’s content typically takes the form of information it generates as well as user-accessible

modules and functionalities. The content dimension assesses how well the system satisfies user needs in the information it produces. Users are more satisfied with a system's modules when they are more comprehensive and informative.

**b. Accuracy Dimension**

The Accuracy dimension determines how satisfied users are with the data's accuracy during the input and information-processing phases of the system. The system's accuracy is determined by seeing how frequently it generates incorrect output after processing user input, in addition to observing how frequently data processing errors occur.

**c. Format Dimensions**

The format dimension measures user satisfaction in terms of the aesthetics of the system interface, the format of reports or information generated by the system, and whether or not the system's user interface is appealing and makes it easier for users to use the system. This can indirectly affect the level of effectiveness of users.

**d. Dimensions of Ease of Use**

The ease-of-use dimension determines how satisfied users are with how simple or user-friendly the system is to use, including how easy it is to enter data, process data, and locate the information they need.

**e. Timeliness Dimension**

The Timeliness dimension determines how timely the system is in displaying or giving the data and information the user needs. A timely system can be thought of as a real-time system, which means that every request or input given by the user will be processed instantly and output will be displayed rapidly with little waiting time.

End-user computing satisfaction is the total emotive and cognitive assessment by the IS end-user of the level of enjoyment and consumption-related fulfillment they have with the IS (W. W. Chin & Lee, 2000; Doll & Torkzadeh, 1988). Cyert and March (Cyert & March, 1963), who initially proposed the idea of user information

satisfaction (UIS) as a proxy for system success contended that an IS that satisfies users' needs increases their contentment with the system. User opinion of an IS's effectiveness is frequently gauged by the level of user information satisfaction (Bailey & Pearson, 1983; Doll & Torkzadeh, 1988) and is related to other important constructs concerning systems analysis and design. End-user computing satisfaction is probably the most widely used measure of IS success. Not only does satisfaction have a high degree of face validity due to reliable instruments having been developed by past researchers but also most other measures are either conceptually weak or empirically difficult to validate (Doll et al., 1995; William H. Delone & Ephraim R. McLean, 2003).

The most frequently used EUCS instrument was developed by Bailey and Pearson (Bailey & Pearson, 1983), who identified 39 factors that can be used to measure the EUCS of IS. This model was first assessed and refined by Ives et al. (Ives et al., 1983) and, later, by Baroudi and Orlikowski (Baroudi & Orlikowski, 1988). As a result, a new shortened model was developed comprising 13 factors, which can be broadly grouped into three main dimensions: (a) information quality, (b) Entry Data Processing (EDP) Staff and Services, and (c) User Knowledge or Involvement. Typical measures of Information Quality include accuracy, relevance, completeness, currency, timeliness, format, security, documentation and reliability. Measures of EDP Staff and Services mainly comprise staff attitude, relationships, level of support, training, ease of access and communication. Finally, measures of knowledge or involvement mainly include user training, user understanding and participation.

Other dimensions such as Top Management Support, Organization Support, or user support structures of any kind, are also suggested as influencing IS user satisfaction (Adam Mahmood et al., 2000; Etezadi-Amoli & Farhoomand, 1996). Additionally, two other IS dimensions, namely System Quality and Interface Quality, are also proposed by other researchers from the IS attributes lists (Adam Mahmood et al., 2000; Etezadi-Amoli & Farhoomand, 1996; Suh et al., 1994). Most measures in the former dimension are

aspects of engineering-oriented technical performance, such as speed, features, robustness and upgrade flexibility. The latter category refers to the interaction between the end-user and the computer system, which consists of hardware devices, software and other telecommunications facilities. These two groups include variables which assign the efficiency of an information system, which has an important impact on the satisfaction of the end-users.

### **3. Task Technology Fit (TTF) Analysis**

Technology is now ingrained in daily life and has become a key component of our civilization. Different technologies continue to shape and shape how people and organizations operate and think (Orlikowski, 2000). A lot of resources are needed for the acquisition, implementation, and use of the many technologies in an organization, but they are often used to generate value by enhancing or supporting individual and group work. The question of how much value the technology generates for a business is therefore frequently asked (Melville et al., 2004).

Because of the complexity of how many system components, including technology, people, systems, tasks, and processes, are connected, it is exceedingly challenging to determine with precision what value technology contributes to a system (Goodhue & Thompson, 1995; Orlikowski, 2000). Therefore, several methods of measuring the impact of technology have been suggested. One such evaluation method, which is well-liked in IS research (C.-C. Lee et al., 2007), is the Task-Technology Fit (TTF) theory which has been suggested to be “one of the most important developments in information system theory” (Melchor-Ferrer & Buendía-Carrillo, 2014). TTF offers a way to determine how effective a company’s use of technology is (Goodhue, 1998). In 2012, Furneaux (Furneaux, 2012) identified the “notable increase in the use of TTF theory”. This trend has continued over the years, with both an increase in the yearly number of documents published as well as in the range of environments which the theory is used.

Despite the widespread usage of the idea, only two works — by Cane and McCarthy (Cane & McCarthy, 2009) and the work of Furneaux (Furneaux, 2012) ]—were discovered that compile and consolidate TTF-related findings. The study by Cane and McCarthy (2009) is restricted to a small number of investigations, all of which were completed before 2006, and solely evaluated how the studies characterized TTF and its surrounding components. To combine the conceptualization, techniques, and research contexts, Furneaux (2012) looked at a significantly wider sample of studies that employed TTF and were all completed before 2010. This study is concerned with why, where, and how TTF was applied, as opposed to the previous two investigations, which were primarily concerned with how TTF was administered. Goodhue and Thompson (1995) states, “Models are ways to structure what we know about reality, to clarify understandings, and to communicate those understandings to others. Once articulated and shared, a model can guide thinking in productive ways, but it can also constrain our thinking into channels consistent with the model, blocking us from seeing part of what is happening in the domain we have modeled.”

The basic TTF model, depicted in Fig. 5.3, therefore provides a lens of technology usage and the value that it creates (Goodhue & Thompson, 1995; Spies et al., 2020). In a setting where technology is used by individual’s to perform certain tasks, or sets of tasks, the model’s premise is that the value/performance of technology is created by the alignment, or fit, of the task requirements and the technology characteristics that allow a user to perform the tasks (Goodhue, 1998; Goodhue et al., 2000).

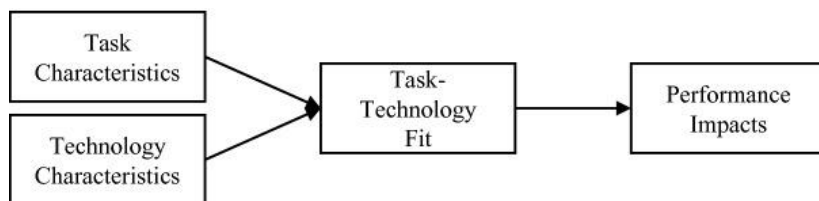


Figure 5.3. Basic Task-Technology Fit Model (Spies et al., 2020)

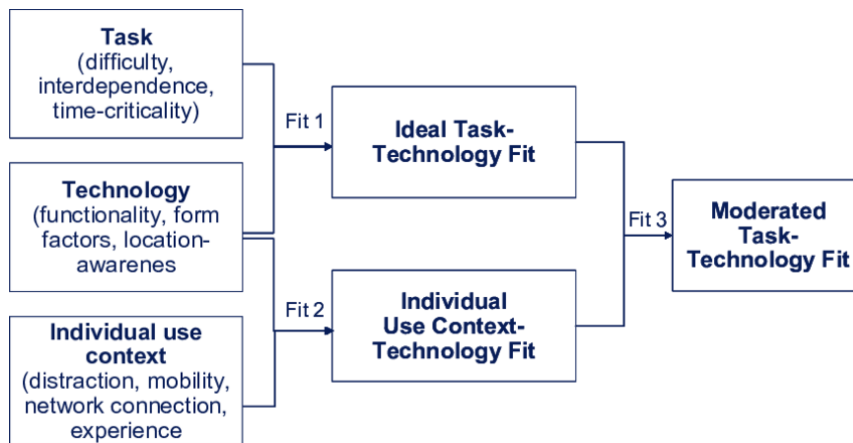


Figure 5.4. Three steps to determine task-technology fit for mobile information systems (Gebauer et al., 2005)

Mobile information systems hold great potential to support organizational processes. Figure 5.4 addresses how to realize that potential, the issues involved, the challenges to overcome, and accordingly, the effective strategy to deploy. Based on Goodhue and Thompson's (1995) general theory of task-technology fit and specific theory for task-technology fit for group support systems (Zigurs & Buckland, 1998), For mobile information systems, Gebauer et al. (2005) offer a particular task-technology theory. A three-way match between the profiles of managerial tasks (operationalized by difficulty, interdependence, and time-criticality), mobile information systems (operationalized by functionality as notification, communication, information access, and data processing; form factors; and location-awareness), and individual use context (operationalized by distraction, movement, quality of network connection, and prior experience) determines task-technology fit. The analysis demonstrates that the design and development of mobile information systems must pay particular attention to form factors (intuitive user interfaces and simple menu structures), verification features, and use scenarios with high levels of distraction and poor network connections. (Gebauer et al., 2005).

Tasks relate to the entirety of an individual's physical and/or cognitive acts and processes carried out in a specific context. Depending on the complexity of the tasks done, varying levels of detail are applied to task characteristics in relation to the technology that supports them (Ammenwerth et al., 2003; Goodhue & Thompson, 1995). Different unique task features will come from using the TTF theory in various situations. In literature, however, the method used to discover the task characteristics is comparable and often entails studying the tasks carried out in a setting and developing several task categories and subcategories that can be associated to TTF (Ali et al., 2018; Goodhue, 1998; C.-C. Lee et al., 2007; Wang & Lin, 2019). Technology is defined as the tools that are used by individuals to execute, or assist in executing, their tasks (Ammenwerth et al., 2006; L. Yang et al., 2013).

#### **4. Human-Organization-Technology (HOT) Fit Model**

W. DeLone and E. McLean in 1992 developed a model that can be used to evaluate the information system quality, namely the "DeLone and McLean Information Systems Success Model (ISSM)" or the Delone and McLean model (William H. Delone & Ephraim R. McLean, 2003). Delone and McLean state that there are six factors that affect the quality of an information system: System quality comes first, followed by information quality, use, user happiness, individual impact, and organizational impact. Delone and McLean enhanced that model in 2003 by incorporating service quality and substituting net benefits for individual impact and organizational benefits.

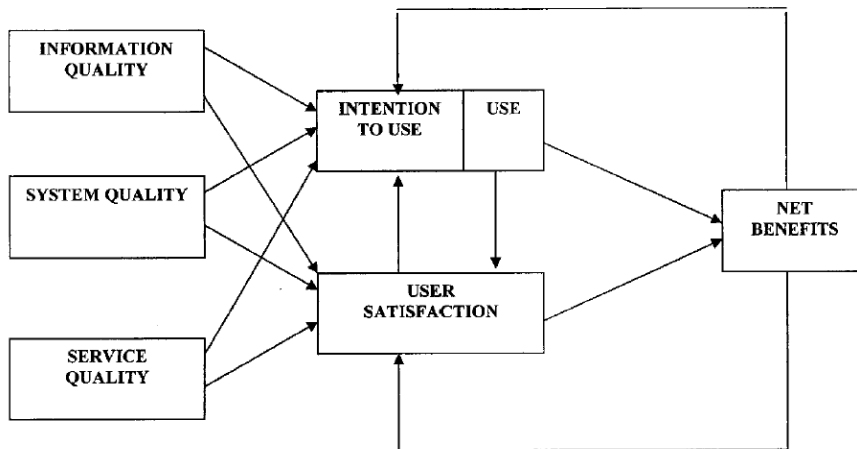


Figure 5.5. Updated DeLone and McLean IS Success Model (ISSM) or the D&M model (William H. DeLone & Ephraim R. McLean, 2003)

The MIT90s is a well-known paradigm of IT-organizational fit in the meantime. The following six criteria must be balanced in order for the organization to successfully manage the deployment of information technology: the external environment, the organization's strategy, the people and their roles, the organization's structure, technology, and the management procedures (Bacsich, 2013).

In 2006, a framework established by Yusof et al. incorporated the IT Organizational Fit Model and the ISSM idea. The framework for evaluating health information systems must take into account both people and organizations. In addition, the technology must be supported and provided for the health information system. Organizations in the healthcare sector must be able to train employees to adapt to new technologies or future changes. The HOT-Fit features three different aspects, each with unique qualities. There are three aspects of technology: system quality, information quality, and service quality. User pleasure and system use are the two dimensions that make up the human aspect. There are two dimensions in the area of organization: (1) structure and (2)



environment. Those dimensions is used to measure the net benefits (see Figure 5.6) (Yusof et al., 2008).

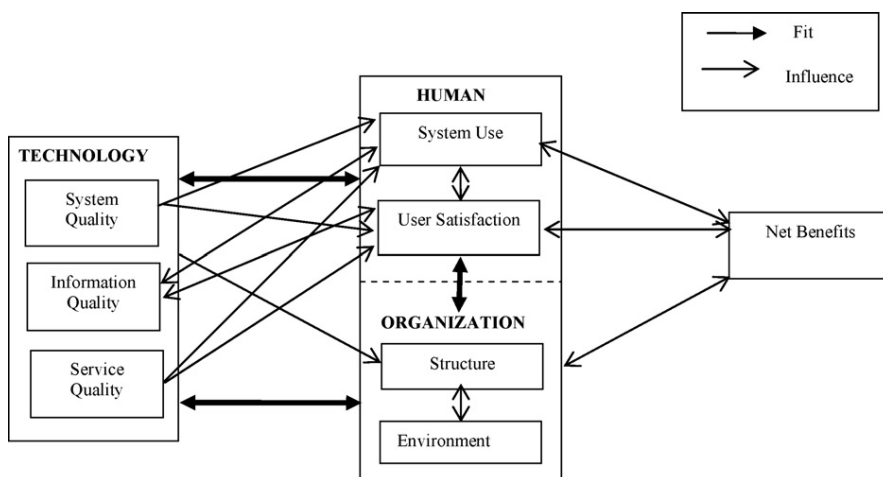


Figure 5.6. Human-Organization-Technology Fit (HOT-fit) Framework (Yusof et al., 2008)

Yusof et al. (2008) developed the HOT-Fit framework to understand the benefits of health information system from three aspects; they are technology, human, and organization. In this research the conceptual model is confirmed because the goodness of fit index (GFI) value is greater than 0.9. Following this, there are two possibilities: (1) if the research data is wrong; (2) if the research data is true. If the data is wrong, there are some possibilities. First, there are mistakes on the interpretation of the questionnaire statement. Second, there is a factor that indicates the users, who use the electronic medical records (EMR) system, did not use the system as the core of their work. Third, there is a mistake to interpret the scale of questionnaire research. If the data is true, there is a conclusion that organization has the biggest effect towards net benefits.

In this research, the effect between technology and human can be seen on the relation between information quality and system quality dimension towards user satisfaction. If we look into the effect

towards net benefits, the environment dimension from organization aspect influence the net benefits. In practical, the organization can affect the net benefits from EMR system. The structure of organization gives significant effect towards organization environment. The management of hospital gives support and implement the right strategy based on environment of organization. There is a need of communication and competition that gives significant effect towards net benefits. Despite that fact, it is not true to ignore the technology aspect. The degree of user satisfaction is affected by the information and service that is provided, but user satisfaction cannot affect net benefits.

The user of EMR system can satisfy with two way of processes, they are working manual with paper and using system. It is true that operating the EMR system isn't their main job. It proves that user satisfaction cannot affect the net benefits. According to that condition so it is needed to give attention towards the using of technology (EMR system) to increase the benefits. Organization can support the implementation of system and make policies so technology can give the benefits.



Explain the next task with your own perspectives for better understanding about digital transformation.

1. Explain the basic principles of the Technology Acceptance model (TAM)
2. Explain the basic principles of the Task-Technology Fit (TTF) model
3. Explain the basic principles of the End User Computing Satisfaction (EUCS) model
4. Explain the basic principles of the Human-Organizational-Technological Fit (HOT) model.



## Summary

Global digitization is developing rapidly and health information systems (HIS) and health information technology (HIT) are gaining prominence in the market. The importance of technology that is available, safe, and usable in healthcare is becoming increasingly important. The diversity of HIS and HIT available in the market is also reflected by the heterogeneity of evaluation models and frameworks currently used in health informatics. Standardization and validation of cross-cultural instruments in the creation of relevant models and frameworks is paramount. Such an approach requires safe, reliable, and efficient technology solutions to be procured and properly implemented in the healthcare environment. There are many models for evaluating health information systems, but students are introduced to the four models that are often used, namely: (1) the Technology Acceptance (TAM) Model; (2) the Task-Technology Fit (TTF) model; (3) the End-User Computing Satisfaction (EUCS) model; and (4) the Human-Organization-Technology (HOT) Fit Model.



## Formative Test 1

Choose the correct answer:

1. What is the name of the organization that aims to unite stakeholders from the fields of statistics and health to develop knowledge and skills and improve the accessibility, efficacy, and use of data for decision-making across all aspects of health?
  - A. Ministry of Health (MoH)
  - B. Health Metrics Network (HMN)

- C. World Health Organization (WHO)
  - D. Centers for Disease Control and Prevention (CDC)
2. What are the two key principles of Technology Acceptance Model (TAM)?
    - A. Perceived Usefulness and Perceived Facility
    - B. Perceived Technology and Perceived Ease of Use
    - C. Perceived Usefulness and Perceived Ease of Use
    - D. Perceived Technology and Perceived Facility
  3. End-User Computing Satisfaction (EUCS) model is based on five independent constructs which are used to estimate the dependent variable (satisfaction). These constructs are...
    - A. content, (2) accuracy, (3) format, (4) ease of use, and (5) timeliness
    - B. format, (2) ease of use, (3) timeliness, (4) accuracy, and (5) validity
    - C. timeliness, (2) reliability, (3) format, (4) content, and (5) ease of use
    - D. format, (2) shape, (3) content, (4) timeliness, and (5) accuracy
  4. Which postulate says that the match between task requirements and technology characteristics predicts the utilization of the technology and individuals' performance?
    - A. Technology Acceptance (TAM) Model
    - B. The Task-Technology Fit (TTF) model
    - C. End-User Computing Satisfaction (EUCS) model
    - D. Human-Organization-Technology (HOT) Fit Model
  5. Which model basically places the three main elements as being important in information systems, i.e., humans, organizations, and technology?
    - A. Technology Acceptance (TAM) Model
    - B. The Task-Technology Fit (TTF) model

- C. End-User Computing Satisfaction (EUCS) model
- D. Human-Organization-Technology (HOT) Fit Model

Check your answers with the answer key on the formative test at the end of this module. Count the correct answers. Then, use the following formula to determine your mastery level of module 1 material.

$$\text{Level of Mastery} = \frac{\text{number of correct answers}}{\text{number of questions}} \times 100$$

The meaning of the level of mastery:



If you reach 80% or more mastery, you can continue with Learning Activity 2. Good! If you are still below 80%, you must repeat the material for learning activity 1, especially the parts you haven't mastered yet.

Keys:

- 1. B
- 2. C
- 3. A
- 4. B
- 5. D

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## UNIT VI

# TELEHEALTH AND TELENURSING

### **Learning Objectives:**

After taking this chapter, you'll be able to:

1. Explain the differences between telehealth and telenursing
2. Explain the competencies of telenursing
3. Identification of the risk management
4. Explain the therapeutic nurse-client relationship
5. Explain the legal aspects of telenursing
6. Explain the telenursing in patient triage
7. Explain the telenursing in health education

### **A. Introduction**

A promising area for incorporating options and methods for nursing activities in research, teaching, and care is telenursing. It is a useful tactic for assisting nations in removing obstacles to healthcare and educating the populace about healthcare. Telenursing aids in the advancement of primary care as well as the procedures involved in rehabilitation and health maintenance. This helps to complement, deepen, and increase the integration of healthcare systems, focusing on patients with chronic diseases who have more difficulty receiving treatment. The studies examined in this review, which involved research done in 13 different nations and a target population primarily afflicted by chronic illnesses, highlight the value of telenursing as a supplement to health systems that are universally accessible and covered by insurance (Souza-Junior et al., 2016).

Telenursing is often used for non-urgent patients. However, if a patient is in a serious situation, telenursing can be utilized to alert their primary physician so they can assess, evaluate, and coordinate transport to the closest medical facility. Faster computer systems, video technologies, wearable sensors, real-time data transmissions, and high-speed internet enable healthcare professionals to provide high-quality, on-time care from a distance in today's technology environment (Schlachta-Fairchild et al., 2010).

Telemedicine use has increased since the COVID-19 pandemic began in 2019 as a result. This is due in part to the fact that patients travel less to medical facilities, increasing the physical distance, and a considerable rise in the number of people seeking preventive care at home (Mohammed & El-sol, 2020). Telecommunication equipment have been fully exploited in the COVID-19 pandemic. In order to stop the spread of viruses, reduce unneeded hospital visits, and safely enable physicians to contact with COVID-19 patients and their loved ones while they are hospitalized. Barriers and learning curves were present during these shifts. Along with widespread fear and uncertainty, an increase in practitioner workload, the need to maintain personal protective equipment (PPE), and the unexpected use of telecommunication to reduce viral exposure, the pandemic brought about new challenges to effective serious disease communication (Flint & Kotwal, 2020).

The COVID-19 epidemic has forced all hospitals, clinics, and healthcare facilities to swiftly adopt telehealth services, and the patient care delivery systems will continue to undergo irreversible change. Despite the fact that telemedicine is "becoming virtual" in the midst of a crisis, health practitioners must be aware of the most crucial transitional phases. Virtual care is already a reality, whether healthcare institutions are ready for it or not (Wosik et al., 2020).

## **B. Differences between Telehealth and Telenursing**

With the prefix "tele-" as a combining form that means "over a long distance," words like "telepathy", "telescopic" or "telemetry" are

created. The term scope, when paired with the prefix tele, has a single, obvious meaning that states: a device for viewing distant events. (Oxford Learner's Dictionaries, 2023) The prefix tele, like other contexts, has multiple connotations in the field of health care. For instance, the term "telemetry" is used to refer to a procedure, data, and an electronic device involved in the task of remotely measuring and reporting relevant information.

In health care, there is an evolving and conflicting terminology for telemedicine. It is now even more challenging to discern between the ontology of terms and describe the safety and quality issues connected to their management and delivery in the context of remote health care. In particular, the terms telehealth, telemedicine, and telenursing have been used in the past literature somewhat indiscriminately, and the few studies indicating safety problems were challenging to cluster for further analysis.

Telenursing or telehealth nursing is the used of "as the practice of nursing delivered through various telecommunications technologies". Telenursing, according to the American Nurses Association, is a subset of telehealth in which the use of "technology to deliver nursing care and conduct nursing practices (Chang et al., 2021). The nurse carries out nursing practice by communicating with a client at a distance in order to electronically get the client's health condition, initiate and transmit therapeutic treatments and regimens, and observe, document, and analyze the client's reaction and nursing care outcomes.

Using technology to provide nursing care changes the way care is delivered and could necessitate the possession of specialized skills, but telenursing does not change the nursing process or the scope of practice (Collada et al., 2023). Nurses who conduct telenursing continue to analyze, plan, intervene, and evaluate the outcomes of nursing care by using technology such as the Internet, computers, telephones, digital assessment tools, and telemonitoring equipment (Glinkowski et al., 2013).

Given the development of health care services provided by teletechnologies, the term "telehealth" is used to denote the scope

of services. The Health Resources and Services Administration's (HRSA) definition of telehealth for the purposes of this analysis is "the use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health and health administration" (HRSA, 2022). The process of providing health care, diagnosis, consultation, and treatment through interactive audio, visual, and data connections is known as telemedicine. It also refers to the transfer of medical data and education (Haleem et al., 2021). The benefit of telehealth to the patient is improved accessibility to skilled, compassionate, and efficient nursing care provided via telecommunications technology (American Telemedicine Association - ATA, 2019).

Other health professions including radiology, pharmacy, and psychiatry are also included in the delivery of telehealth treatment, in addition to doctors and nurses. The terms "teleradiology," "telepharmacy," "telepsychology," and similar terms refer to the fact that these fields also provide care using electronic information and telecommunications technologies. These fields are purposefully excluded here even though they are not the subject of this review for two reasons: (1) The safety concerns associated with care delivered using electronic and telecommunications technologies are more similar than they are different among the various health disciplines, and (2) The authors were compelled to include significant research from other health disciplines due to the paucity of research on safety and quality in the telenursing literature (Schlachta-Fairchild et al., 2010).



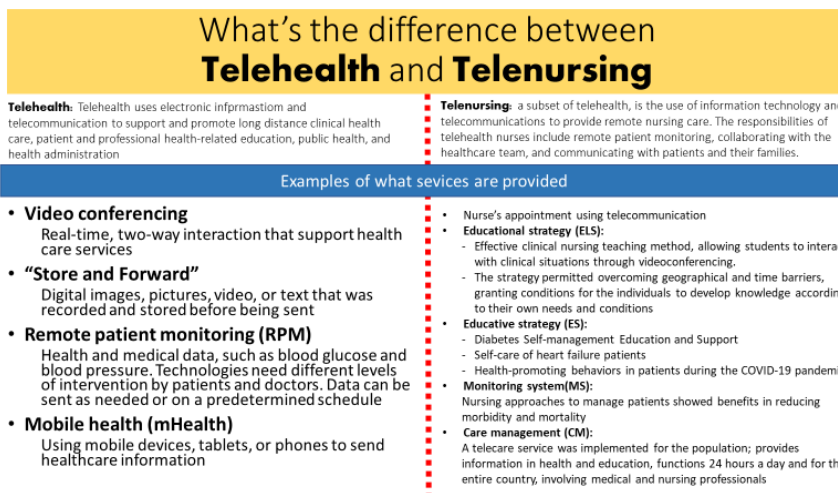


Figure 6.1. Differences between telehealth and telenursing (PAVE, 2023; Rutledge & Gustin, 2021; Siminerio et al., 2014; Souza-Junior et al., 2016)

### C. Competencies

Nurses must use their knowledge, skills, and judgment to:

1. adequately assess clients;
2. work with clients to design the nursing plan of care;
3. implement interventions; and
4. evaluate the care.

Additionally, nurses need to be able to tell when telenursing is no longer meeting the needs of the patients and a face-to-face evaluation is necessary. The Department of Health and Wellness's provision of publicly financed virtual health services policy governs nurses who deliver publicly supported services via telenursing. Additionally, nurses who use telenursing should think about acquiring additional expertise (competencies) in:

1. Client teaching;
2. Communication;
3. Counselling;
4. Interpersonal skills; and,
5. Use of telenursing technology.

Nurses must evaluate their level of competence, identify any knowledge gaps, and seek out education to fill them. Through a targeted formal educational program, sufficient orientation, vendor training, and mentoring, competence and effectiveness in telenursing may be improved (NSCN, 2023).

#### **D. Risk Management**

Telenursing can be a higher-risk technique because it does not allow for the same touch as face-to-face care. To reduce this risk, it is crucial to have clearly defined accountabilities, employment responsibilities, and practice-supporting rules. Risk management plans and associated policies should be developed and documented with input from nurses who are providing care via telehealth. When creating telenursing rules, employers should take the following factors into account (this is not an entire list) (NSCN, 2023):

1. Process to determine if telenursing will meet the client's needs
2. Choice of technology
3. Management of care when telenursing no longer meets client's needs
4. Addressing situations when a client ends the nurse-client relationship before the nurse is satisfied all concerns have been managed
5. Consultation with another provider when the situation exceeds the nurse's scope of practice
6. Procedure to follow if telenursing technology is not working or unavailable
7. Informed consent (verbal, written, recorded)
8. Privacy and confidentiality
9. Documentation
10. Security and ownership of client records
11. Appropriate video/telephone behaviors
12. Liability protection

13. Process for ordering pharmacological, non-pharmacological and diagnostic tests
14. Sending and receiving consultations and referrals

### **E. Therapeutic Nurse-Client Relationship**

Therapeutic nurse-client relationships are intentional, goal-directed bonds between a nurse and a patient built on mutual respect and trust that eventually serve to uphold the client's interests. The client's requirements are being met by this dynamic, goal-oriented, and client-centered interaction. No matter the setting or duration of the engagement, the therapeutic nurse-client relationship safeguards the patient's privacy, autonomy, and dignity while fostering a relationship of trust and respect. A nurse's standards of practice must include the creation, maintenance, and termination of therapeutic interactions (Al Baalharith et al., 2022).

Relationships between nurses and their patients must be based on the nurse's assessment and appraisal of the patient's healthcare needs, whether they are created face-to-face or via telecommunications technology. Clients' cultural (including linguistic), spiritual, and psychosocial needs and preferences should be taken into account at all times in therapeutic relationships. All nurse-client relationships require effective communication, but when information and telecommunications technologies are being used, this is more important (Zakeri et al., 2020).

### **F. Legal Aspects of Telenursing**

#### **1. Privacy**

The privacy and security of electronically recorded information, such as electronic health records (EHR), protected/personal health information (PHI), progress/therapy notes, and assessment reports, are often governed by state regulations that nurses must follow. Service providers must abide by Law Number 27 of 2022 Concerning Personal Data Protection in order to ensure the security and privacy of such information and to avoid facing legal repercussions. The Security and Privacy Rule

must be strictly followed by professionals using health information technology. A security strategy that protects electronically stored information must be created by covered entities, who are commonly characterized as people or companies that offer or are paid for offering healthcare services, in accordance with the Personal Data Protection Law (UU No. 27 Tahun 2022, 2022).

## **2. Confidentiality**

Patient confidentiality is the term used to describe patients' right to maintain the privacy of their medical records as well as the moral and legal duties placed on doctors and other healthcare providers when handling patients' private and sensitive medical data (Bourke & Wessely, 2008; Tegegne et al., 2022). Covered entities are healthcare organizations, such as hospitals, doctors' offices, and nursing homes, that deal with patient health information. As stated by the Health Insurance Portability and Accountability Act (HIPAA) of United States legislation Privacy Rule, which forbids medical personnel from lawfully disclosing patient information without the patient's agreement, they are accountable for maintaining patient confidentiality (Tariq & Hackert, 2023).

The protection of patient privacy serves the interests of both patients and doctors. It guards against the misuse of patient data. Additionally, it is in the best interests of the doctors. For instance, doctor-patient confidentiality privileges allow doctors to build relationships with patients based on trust and open communication, improving the quality of care they provide. These privileges reassure patients that their health information is safe and will only be used to improve health outcomes (Networks et al., 1994; Tariq & Hackert, 2023).

Social Security Administration for Health (BPJS Kesehatan) ensures the management of data and information systems that are managed in accordance with applicable regulations, namely ISO 27001 certification. As well as implementing Control Objectives for Information Technologies (COBIT) and operating a Security Operation Centre (SOC) that works for 24 hours 7 days or

continuously. ISO 27001 is a standard document in the information security management system that provides an overview of what a business stakeholder must do in implementing the concept of information security (Rahajeng, 2021).

### **3. Informed Consent**

The use of telehealth technology involves several legal and ethical problems, as shown by the previous section (Barnett & Scheetz, 2003). When telehealth technologies are used, one problem that may merit more in-depth discussion is informed consent. An individual has the right to communicate with others about their private ideas, opinions, and behaviors, according to the law and numerous professional codes of ethics. An individual must offer informed consent before deciding to share their private ideas, views, and behaviors (Gupta & Kharawala, 2012).

Informed consent is a format of action carried out by medical personnel on patients/families of patients who will undergo action/operation. In preparing the informed consent format there is the sentence "...and I will not file a lawsuit if losses occur as a result of the action (surgery, etc.) carried out..." then the patient/family signs at the end. When something undesirable happens after surgery, most of the patient's families sue and even take legal action. Informed Consent is essentially the civil aspect of informed consent when linked to the law of engagement where in the Civil Code/BW article 1320 contains 4 (four) conditions for the validity of an agreement, namely:

- a. There is an agreement between the parties, free from coercion, error and fraud;
- b. The parties are competent to enter into an agreement;
- c. There is a certain thing that is made into an agreement;
- d. The existence of a lawful cause, which is justified and not prohibited by statutory regulations and is a reasonable cause which must be fulfilled (Ta'adi, 2013).

The same laws and regulations governing consent apply to telenursing as they do to all other forms of nursing care. In telenursing, consent may be either implicit or explicit. In contrast to using video conferencing from a client's home to track the progression of a chronic disease, which may require explicit consent, a client accessing health information via for example 119 unit constitutes implicit consent. Prior to assessment and nursing care, informed permission is essential. To create a policy to direct the informed consent procedure, telenursing nurses should work together with their employer, the legal department, and/or the risk management department (NSCN, 2023).

### **G. Telenursing in Patient Triage**

Telenursing triage and advice services are continuing to expand both nationally and internationally. A primary role of telehealth nursing triage is to channel patients or clients towards appropriate levels of care, thereby reducing healthcare costs and freeing up resources (Gidora et al., 2019).

The use of telephone triage and advising services (TTAS) is spreading throughout the world. Through these services, customers can consult a nurse or general practitioner over the phone to get a medical evaluation and advice. There is a corpus of study on the subject of TTAS, but because the evidence base is dispersed, it is challenging to pinpoint the main ideas that run through the literature. The most advanced degree of evidence synthesis is represented by systematic reviews. To ascertain the breadth, consistency, and generalizability of findings in regard to the governance, safety, and quality of TTAS, we set out to conduct an overview of such reviews (Lake et al., 2017)

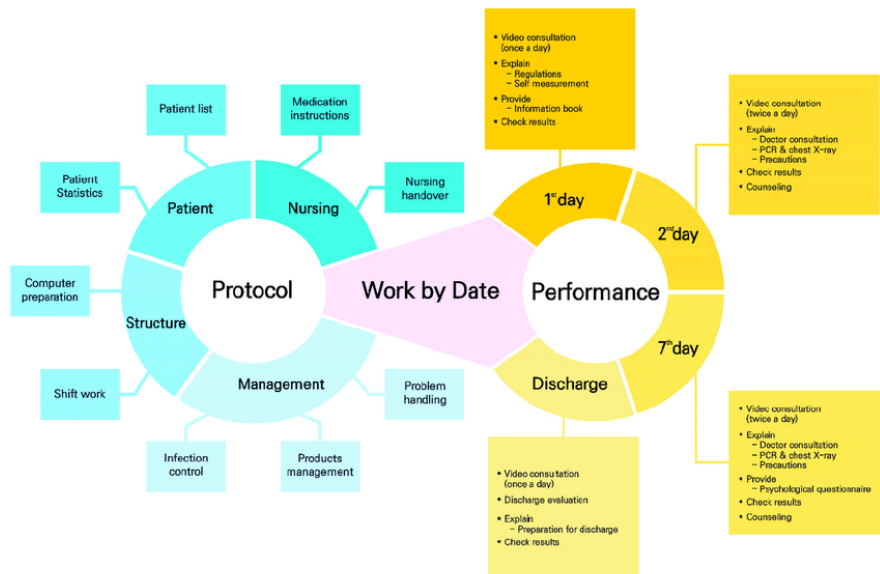


Figure 6.2. The protocol development process of Telenursing Service for the Community Treatment Center (Heo et al., 2021)

Questions about the level of care delivered, equity of access, costs, and outcomes are not fully addressed by the available research at this time. The information that is currently available also points to a number of interactional elements (such as relationships with other health service providers) that may have an impact on performance metrics as well as the external validity of research findings. Patient views and provider communication effectiveness interacted to influence patient compliance with triage recommendations, and both were mediated by access to health services (Purc-Stephenson & Thrasher, 2012).

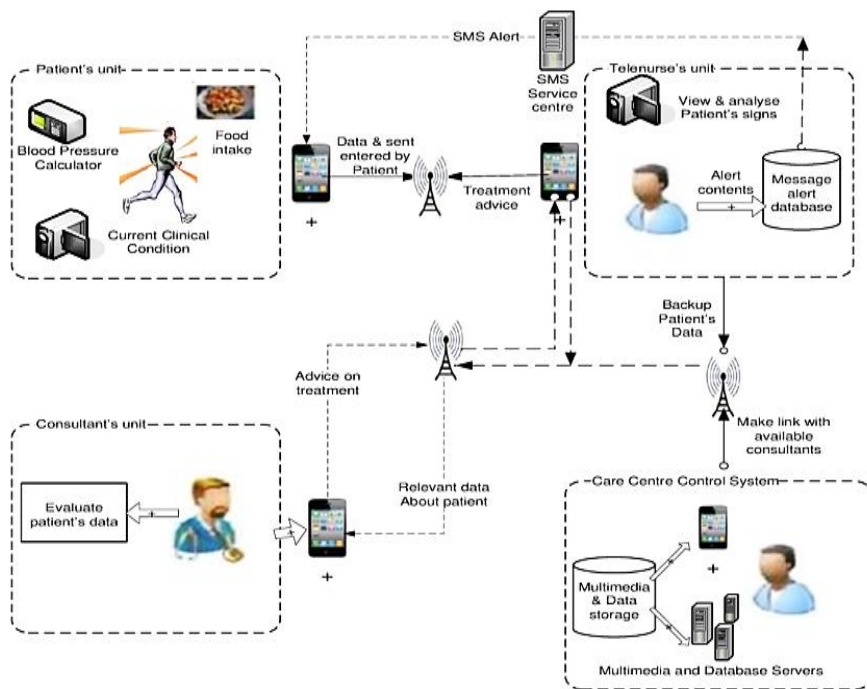


Figure 6.3. Framework of the mobile telenursing system (MTS) system (Adigun *et al.*, 2017)

## H. Telenursing in Health Education

Telenursing in health education is included in several literatures: (1) using social media to enhance students' confidence and/or self-efficacy, (2) characteristics of nurses who use social media, and (3) preferred modes of communication. Further research is still needed to reveal the impact of Twitter and Facebook on nursing education as well as other specialties of nursing practice (Asiri & Househ, 2016). Telenursing has benefits in providing health education to patients with chronic diseases. People with chronic diseases can maintain and improve their independence, health, and quality of life by engaging in health-promoting behaviors (HPBs) (Feng *et al.*, 2020). Contrarily, chronic illnesses are linked to a decline in HPBs in chronic conditions patients (i.e. multiple



sclerosis) (Borghi et al., 2018). With HPBs, a type of planning and function carried out to avoid sickness, promote health, increase productivity, and prevent negative repercussions, people can maintain and control their health (Edington et al., 2015). According to Jeon et al. (2020), patients with chronic conditions had worse health behaviors than healthy individuals. HPB levels were also observed to be lower in chronic illnesses patients compared to healthy individuals by Saadat et al. (2019).

According to Fraser et al. (2013), patients with chronic illnesses need tailored, well-thought-out treatment plans that mitigate the disease's progression and equip them with the self-care skills they need. Workouts that enhance physical, sensory, motor, and mental function coordination are included in these regimens, according to Kubsik-Gidlewska et al. (2017). According to Monaghesh & Hajizadeh (2020), telehealth is considered an essential tactic for safeguarding patients and medical personnel within the COVID-19 pandemic. This is because it reduces interpersonal contact, hence delaying the spread of viruses.

Technology for telenursing is described as a way to control patient access to healthcare services at any time and place, while also providing more support for self-care (Balenton & Chiappelli, 2017; Dehghani et al., 2023). The care model can be changed from being hospital-centered to community-centered and from being care-centered to client-centered thanks to technology (Rouleau et al., 2015). Telenursing has the potential to enhance lifestyle-related behaviors in chronic diseases and treat cardiovascular disorders, as highlighted by Moriyama et al. (2021). In light of the COVID-19 pandemic, Motl et al. (2020) recommended quick dissemination and coverage of telepsychology services (both video and telephone) for patients with chronic illnesses. Furthermore, telenursing for chronic diseases may encourage patients to take better care of themselves more than standard clinic care, according to Kotsani et al. (2018).

Telenursing can also help patients with chronic illnesses in remote places maintain their own health, according to Piscesiana & Afriyani (2020). Although poor self-care habits were noted in chronic

illnesses patients, educational programs and ongoing telephone follow-up have in the past enhanced awareness, promoted healthy behaviors, and encouraged self-care (Domingues et al., 2011; Habibi et al., 2021).

Telenursing has been shown to be beneficial for chronic illnesses, and in recent years, it has helped patients with long-term illnesses stay in nursing homes longer and avoid hospitals. But as of yet, telenursing lacks a consistent procedure (Borhani et al., 2013). Consequently, teletherapy techniques can lower costs and the patient's requirement for ongoing access to medical facilities, making them crucial in the recovery process from chronic conditions (such as multiple sclerosis and diabetes mellitus).



Explain the next task with your own perspectives for better understanding about digital transformation.

1. Explain the differences between telehealth and telenursing
2. Explain the competencies of telenursing
3. Explain the legal aspects of telenursing
4. Explain the telenursing in patient triage
5. Explain the telenursing in health education



Hospital administrators' capacity to hire nurse staff is being impacted by the nationwide nursing shortage. Shortages of nurses in the field lead to longer nurse-to-patient ratios and more work for staff members. A higher workload is associated with longer patient stays, readmission rates, patient safety mistakes, and hospital-

acquired infections in addition to missing nursing services. Nurse workload and shortages have not been addressed by telehealth services, despite early gains in care quality outcomes. Telenursing may be able to stop the negative cycle of outcomes by offering extra nursing support to counterbalance the strain of bedside nursing professionals.

The literature contains a number of definitions of telenursing, but no concept analysis of the practice has been released. Telenursing may be able to stop the negative cycle of outcomes by offering extra nursing support to counterbalance the strain of bedside nursing professionals. The literature contains a number of definitions of telenursing, but no concept analysis of the practice has been released. To include the idea of telenursing into studies on nursing shortages and patient and nurse outcomes in acute care hospitals, one must have a basic understanding of the concept. The author defined the term “telenursing” and provided a model case, a related case, and a contrasting instance to illustrate the notion using Walker and Avant’s eight-step process.



Choose the correct answer:

1. What are some benefits of telenursing?
  - A. Increased access to healthcare, reduced healthcare costs, improved patient outcomes, and convenience.
  - B. Decreased access to healthcare, increased healthcare costs, improved patient outcomes, and inconvenience.
  - C. No change in access to healthcare, no change in healthcare costs, no change in patient outcomes, and inconvenience.
  - D. Decreased access to healthcare, increased healthcare costs, worsened patient outcomes, and inconvenience.

2. What are the challenges in telenursing?
  - A. Inadequate communication with patients, lack of personal connection, difficulty in assessing non-verbal cues
  - B. Limited access to medical resources, difficulty in building trust with patients, lack of physical presence
  - C. Lack of training and education, high cost of technology, language barriers
  - D. Lack of physical assessment, limited patient interaction, technical difficulties, and maintaining patient privacy and confidentiality.
  
3. How does technology play a role in telenursing?
  - A. Technology has no role in telenursing.
  - B. Technology enables remote patient monitoring, video consultations, electronic health records, and telemedicine platforms.
  - C. Telenursing does not require any technological support.
  - D. Technology only complicates the process of telenursing.
  
4. What are some ethical considerations in telenursing?
  - A. Using outdated technology, neglecting patient privacy, providing care without informed consent
  - B. Ensuring informed consent, providing culturally sensitive care, addressing potential technology-related issues
  - C. Maintaining patient privacy and confidentiality, providing culturally sensitive care, addressing potential technology-related issues
  - D. Maintaining patient privacy and confidentiality, ensuring informed consent, providing culturally sensitive care, addressing potential technology-related issues
  
5. How does telenursing impact patient outcomes?
  - A. Telenursing can worsen patient outcomes.
  - B. Telenursing has no impact on patient outcomes.

- C. Telenursing can improve patient outcomes.
- D. Telenursing has a neutral effect on patient outcomes.

Check your answers with the answer key on the formative test at the end of this module. Count the correct answers. Then, use the following formula to determine your mastery level of module 1 material.

$$\text{Level of Mastery} = \frac{\text{number of correct answers}}{\text{number of questions}} \times 100$$

The meaning of the level of mastery:



If you reach 80% or more mastery, you can continue with Learning Activity 2. Good! If you are still below 80%, you must repeat the material for learning activity 1, especially the parts you haven't mastered yet.

Keys:

- 1. A
- 2. D
- 3. B
- 4. D
- 5. C

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## UNIT VII

# SPSS FOR NURSING STUDENTS

### **Learning Objectives:**

After taking this chapter, you'll be able to:

1. Identify basic of SPSS
2. Explain the basic of SPSS
3. Explain how to create new data using SPSS
4. Explain how to analyze data using SPSS
5. How to make an output data from SPSS
6. How to analyze inferential statistics using SPSS

### **A. Introduction**

The acronym SPSS denotes the Statistical Package for the Social Sciences. The major target demographic of SPSS is widely recognized to be academics and students, particularly those in the field of social sciences. The presence of this functionality in other domains, such as business, can be attributed to its user-friendly nature, characterized by a point-and-click interface. This interface facilitates the seamless compilation of code and enables users to store it as a syntax file. These files can then be readily reused, modified, and shared with others. One notable advantage of SPSS resides in its user interface, characterized by the utilization of dropdown menus, facilitating a user-friendly experience and promoting ease of acquisition. One popular critique of SPSS pertains to its user interface, which facilitates the simplification of statistical analysis. This ease of use, however, carries the potential risk of oversimplifying analyses and enabling individuals to do tests

without a sufficient comprehension of the underlying concepts, thereby promoting superficial analysis. International Business Machines Corporation (IBM) is a multinational technology company that specializes in the development of statistical software specifically designed to handle cross-sectional data, which refers to data collected from several cross-sections during the same time period.

SPSS conducts data analysis through three fundamental methods:

- a. Describe data using descriptive statistics such as frequencies and standard deviation.
- b. Additionally, it seeks to investigate the relationship between variables through methods such as correlation analysis and regression analysis.
- c. Furthermore, it aims to compare different groups in order to establish if there are any significant differences between them.

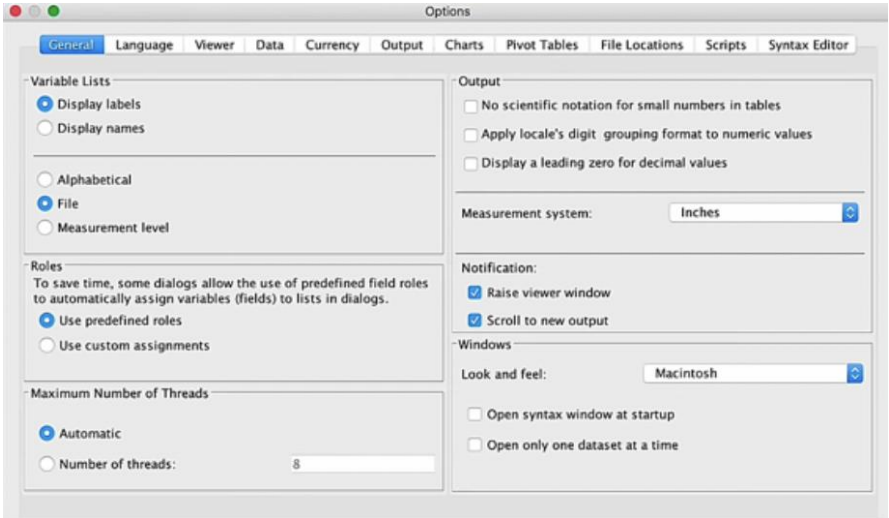
## **B. Basic of SPSS**

Upon launching SPSS, users are greeted with a splash page that displays the version of the software being used. Subsequently, a Welcome Dialogue box is presented, offering various options such as accessing files and additional features of SPSS, including Help and Support, Tutorial, SPSS Community, and What is New on SPSS. The dialogue box of the SPSS 27.0.1 upgrade features a functionality known as Restore Points. The functionality of Restore Points enables the preservation of analytical work by facilitating the retrieval of a previous state or the ability to revert to an earlier phase. The Recent Files feature provides users with the ability to resume working on a project from the point at which they previously ceased progress. The third alternative among the available options is the sample files, which encompass data, syntax, or output.

### **1) Customizing SPSS Default Settings**

The IBM SPSS statistics software is equipped with preconfigured settings that determine its operational functionality,

data manipulation and handling procedures, and output presentation methods. Although the default settings may suffice, it is worth considering the option of customizing them in order to modify the visual appearance and user experience of SPSS. Commence the process by selecting the Edit menu and subsequently opting for the Options feature, thus initiating the opening of a dialogue box. The Options dialogue box contains special options that can be accessed using the tab located at the top of the dialogue box.



General: Within Variable Lists, you can determine where labels and names appear by default within the data Editor. The general pane provides options to modify the presentation of various software components. The language menu can be set to any language desired for working within the software.

The observer is the Output window, the window that appears following the execution of an analysis. Under the Item Icon in the Initial Output State drop-down menu is a list of icons with their respective names. When an analysis is executed, certain outputs are generated; however, not all outputs are displayed; you can determine which outputs are Hidden and which are Displayed by

selecting the appropriate options. The command syntax is displayed at the top of the Output window titled log when the Display commands in the log checkbox in the bottom-left corner of the dialogue box is selected. The default Title and Output parameters can also be formatted as desired. In Page Setup, under Orientation, Landscape is typically recommended over Portrait because it facilitates the manipulation of wider tables. Data: This enables the default data view to be set. In other words, the numerical presentation and arrangement of data can be adjusted to a preferred default configuration. Change the Transformation and Merge Options to Calculate values before use if you anticipate analyzing a large data set containing thousands of entries. You can also specify a date range that SPSS will automatically select if the written year falls within it. The Customize Variable View option enables you to select which elements will be displayed in the variable view and how they will be arranged. However, the only variable views you require by default are the ones that SPSS displays, namely name, label, type, and measure. You should only alter the settings for Random Number Generator, Assigning Measurement Level, and Rounding and Truncation of Numeric Values (adjusts fuzz bits) if you are using these options and know how you want them to behave differently.

This tab has limited options for currency. The default configuration for the Decimal Separator will vary depending on the region in which the software is sold. In the Outline Labelling section, you can specify how labels, values, and variable names are displayed. However, this largely depends on your variables. Additionally, these parameters can be toggled ON or OFF in the data view window.

This is used to save time later when working to make the chart appear in a certain manner, such as APA style, by formatting the various options. However, you may still need to do some formatting later, although the majority of formatting has been completed. In addition to the settings you establish, the Chart Templates option provides access to SPSS-provided templates.

- **Pivot Tables:** By default, all tables displayed in the Output are formatted in a specific manner. You can alter the appearance of your table by modifying the template in Tablelook. To improve how a wide table fits on a page (landscape or portrait), select Shrink width to fit from the drop-down menu in the option Copying wide tables to the clipboard in rich text format. The font size may be reduced, but everything will still fit within the table.
- **File Locations:** This is a tremendous asset for organizing datasets and outputs. This enables SPSS to save specified files in a particular folder. This can also reduce the time spent searching for the folder when the time comes to save. The default settings for this script are sufficient, and it is not recommended to alter anything without an in-depth understanding of its components.
- **Grammar Editor:** This format the syntax window in terms of its color, accessibility, and display.

The primary distinction between SPSS and a spreadsheet is that SPSS's data editor interface includes both a Data View and a Variable View. Although they both express the same sentiment, they do so in different methods.

## **2) Properties of SPSS Variable view**

The variable's name is used to identify it.

**Label:** The use of labels distinguishes SPSS from other programs in a significant way. A label in SPSS enables you to describe your variable in greater depth.

**Type** is another essential property. Type refers to the variable's fundamental data type. The default type will always be numeric due to the prevalence of numbers in data analysis. It is, however, modifiable by clicking on it and selecting the appropriate data type option. A data type can also be a string variable, which refers to the data's letters or words.

This indicates the magnitude of measurement that will be utilized. In statistics, there are four scales of measurement.



- Nominal: Which one? What sort?
- Ordinal: In what sequence? When?
- Interval: How numerous? How much is it?
- Ratio: quantity, absolute, no zero.

Nominal in SPSS corresponds to nominal, ordinal to ordinal, interval to interval, and ratio to scale. Each of these has a unique identifier used to identify it within a data set.

Width: This specifies that the string variable can be either narrow or broad.

This option specifies how many decimal places will be displayed; the default is two decimal places, which can be increased or decreased.

Values: The value property allows you to numerically designate the label. When the value property is selected, a dialogue box appears in which you can assign a value to each label. In the dialogue box, there is an option to add what you have defined and to verify for spelling errors. Click the Value Label icon in the menu bar to toggle between the number and value labels.

Missing: The user-defined value that signifies missing data for a given variable This column enables the user to enter alternative codes for missing values. To assign a missing value to a variable, click on the missing property for that variable, toggle Discrete Missing Values in the resulting dialogue box, enter the missing value, and click OK. However, for the string value, all strings are regarded as valid unless they are explicitly marked as invalid.

Column: This specifies the width and height of the columns, regardless of the variable in the data view. This is related to width, but both are essential when working with string variables. Adjusting the breadth of a column in data view will affect the values displayed in column properties in variable view. Alternately, you can set the column width in the Variable view, which will result in a change to the variable's width measurement in the Data view. Note, however, that a change in column width has no effect on the variable's width setting.

**Align:** This allows you to align the data to the left, right, or center. All of the numeric variables are aligned to the right, while string variables are aligned to the left.

**Role:** This section defines the function of each variable in the analysis. Whenever a variable is defined as input, it is an independent variable. Defining a variable as target indicates that it is a dependent variable. Both mean a variable can be either independent or dependent. None means the variable is neither dependent nor independent. The process of partitioning divides the sample of the variable being analyzed. Based on the value of a variable, Split divides a data set into categories. To designate the properties you want to see on your data set, select SPSS Statistics from the main menu, click on Preferences, select the Data tab, click on the Variable View option, and deselect the properties you don't want to see.

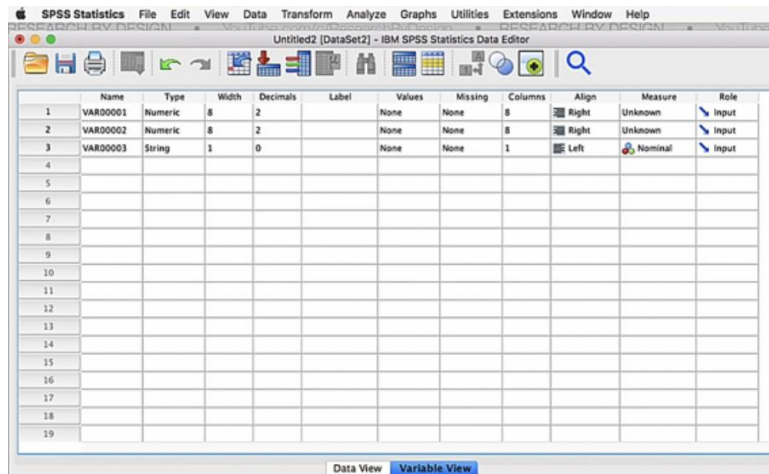
Simply entering a new variable's name allows its creation. To delete a variable, select it and select Clear from the Edit menu. When designating variables in SPSS's Variable View, the following guidelines apply:

- 1) No use of spaces (use an Underscore or Camelcase instead)
- 2) No use of most special characters in the beginning of the name (@ & %)
- 3) Cannot begin with number(s)
- 4) Variables names must be individually unique
- 5) Not more than 64 characters
- 6) Never end a variable name with a period, as SPSS will treat it as part of a command, thereby terminating the analysis when it reaches the period.

### **C. Creating new data**

To create new data, select File > New > Data from the File menu. The variable view will open for the new data file. Data View is essentially a spreadsheet where you can input numbers. When you input a number into a column, you will notice that the column comes to life and the variable is given a name automatically. In the

Variable view, however, creating a variable is as straightforward as typing a new name into an empty variable. Variables are organized and structured in variable view. Any modifications made to the Variable View are reflected in the Data view. To rapidly toggle between Data and Variable views, double-click on a column header. In the Variable view, each variable is represented by a row and its properties by columns. When a variable is created, SPSS automatically populates its properties.



Nevertheless, since these default properties are likely not what you desire, you can modify them and create superior variable names. To select multiple variables simultaneously (multiple), click the first variable, hold Shift, and click the last variable. Adjusting the breadth of each column is as simple as hovering over the line between the column names, which transforms the pointer into a separating icon, and dragging the column headers.

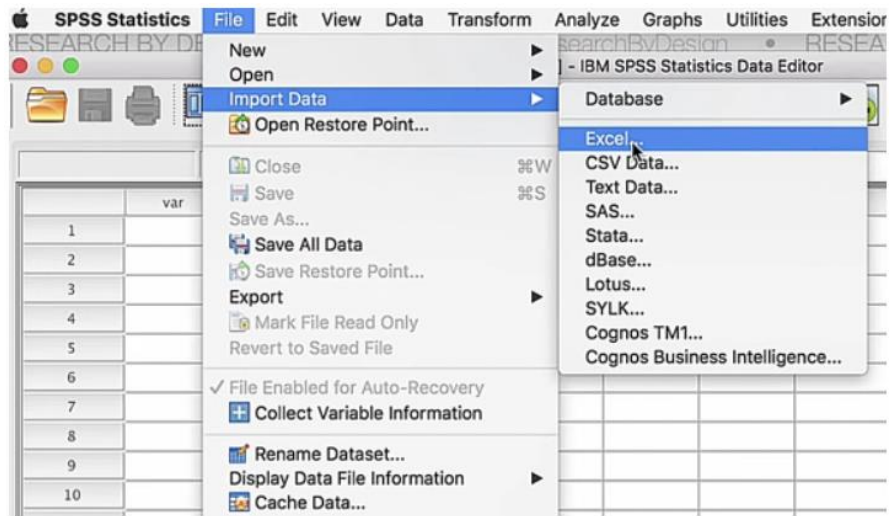
Name	Type	Width	Decimals
VAR00001	Numeric	8	2
VAR00002	Numeric	8	2
VAR00003	String	1	0
ThisisaREALLYlongVariableName	Numeric	8	2

Although a variable name is a good identifier with a few restrictions on what can be entered, there are instances when you may want something more descriptive, necessitating the use of Label. Labels can contain approximately 256 characters, including spaces and other characters that are not permitted in variable names. So while you may be unable to give your variable name an appropriate description due to SPSS rules that limit the number of characters, you can give it a descriptive label.

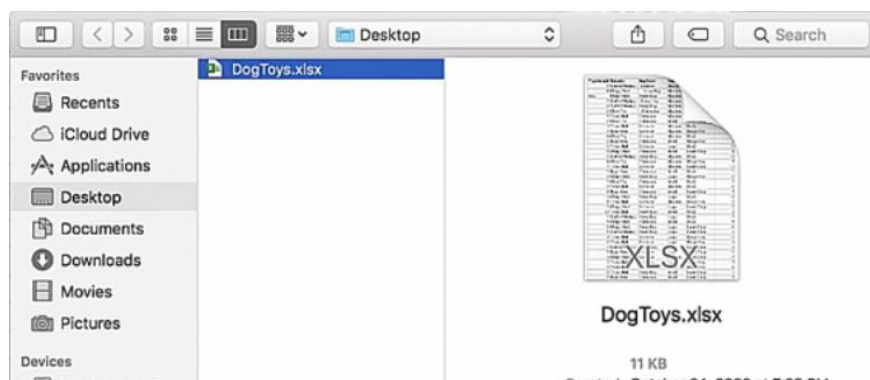
Name	Type	Width	Decimals	Label	Values
Random_ID	Numeric	8	2	Random identification number	None
Group	Numeric	8	2	Experimental Group	None
Sex	String	1	0		None
ThisisaREALLYlongVariableName	Numeric	8	2		None
Height	Numeric	8	2	Height in Inches	None
Weight	Numeric	8	2	Weight in pounds	None

To arrange variables on a dataset, click and drag them over other variables to adjust the position.

SPSS is primarily utilized for data analysis, and Microsoft Excel is a common format for data. Importing data is preferable to manually entering data because SPSS can open well-formatted files in TXT (text), CSV (comma-separated value), XLSX (Excel file), as well as data from other well-known statistical software programmed.



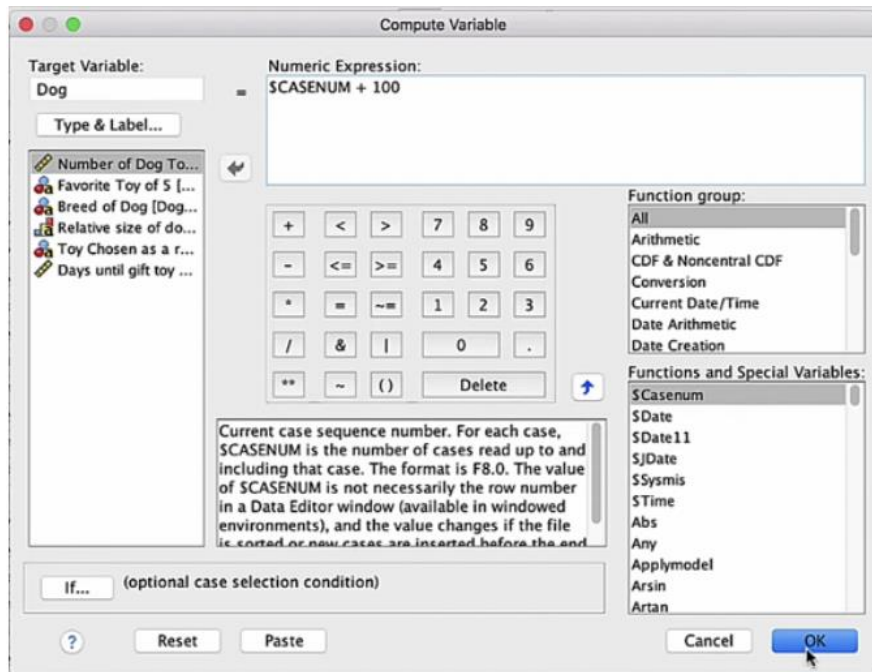
When importing a data file into SPSS, verify that the file is not already open in another application. Open **SPSS**, navigate to the File menu, select Import Data, and then select the software application from which you wish to import the file. This will open a dialogue pane containing the desktop locations where the software data you wish to import is stored. After locating the file, click on its name and then select Open.



Cleaning data from import: This will launch a data wizard that displays the default import settings for the data. In this dialogue box, there are checkboxes to import variable names that are already present in the data and to determine the data level of measurement; numeric variables will be imported as scaled and worded variables will be imported as string variables (categorical data) that are not numeric. Even if there is a word variable among the numeric variables, SPSS will remove the word variable and import it as a numeric variable if the numeric variables make up at least 95% of the total. Also, this option allows you to ignore concealed columns and rows and remove leading and trailing spaces from variables. This is secure, as everyone is aware that SPSS prohibits such spaces and can identify them as data errors. Finally, select OK.

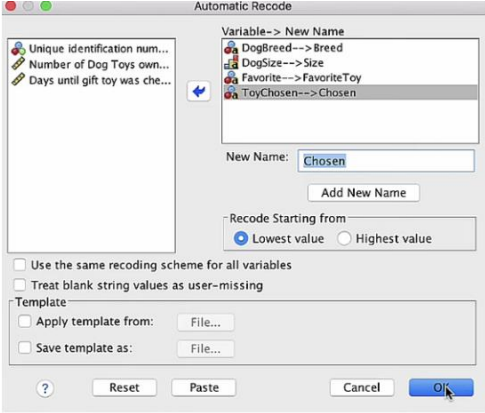
Improving data: A feature that can be used to enhance these data is assigning a unique number to each case. To compute a case number variable, navigate to the Transform menu and select the first option, Compute Variable. Here, you can create a variable or use an existing one. When creating a new variable, specify its type and designation. If you are creating a variable from a mathematical expression, you can use the expression itself as the variable label. Use one of SPSS's built-in functions for the Numeric Expression field in the Compute Variable dialogue window. This is readily accomplished by clicking the Functions group. Casenum is the first available function listed below. When a function is clicked,

information about the function will emerge. This aids in the interpretation and application of a function. To employ the Casenum function, simply select and drag it into the Numeric Expression box. By default, the function will begin numbering with 1, but you can add a constant such as 100 to start numbering with 101. When complete, select OK.



Another method for improving a dataset is to convert string variables to numeric variables and assign the words as variable labels. In lieu of doing this manually, which is laborious, simply navigate to Transform and select Automatic Recode. This will open a dialogue box where your variables are organized, and you will be able to transfer each of the string variables listed on the left to the (Variable-> New Name) field. Enter a new name for the variable in the New Name field and select the Add New Name button. The new name will be treated as a Factor (This is another name for a categorical variable used as a grouping variable, predictor, or

independent variable in an analysis). When you are done recoding all the string variables click OK, as all the other settings are good at their default.

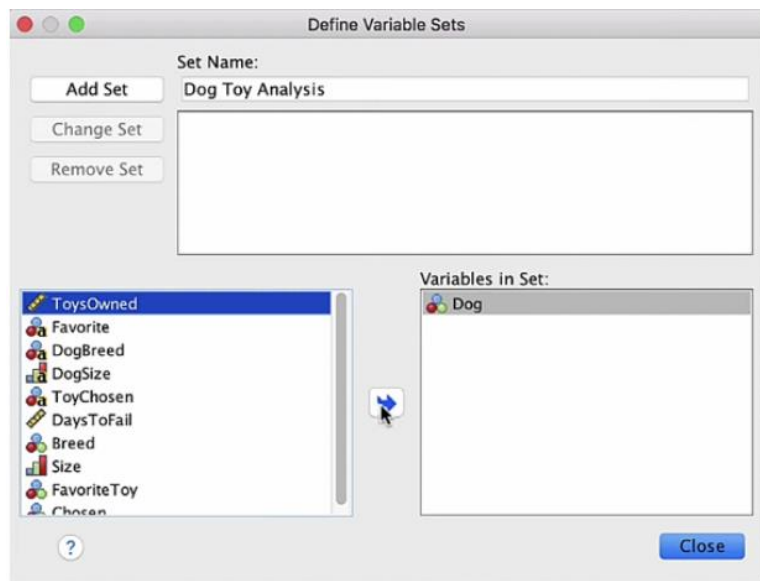


On the dataset, each of the recoded string variables can now be viewed as additional variables, each with their new label (the same as the original label), each set to nominal level of measurement, and value labels appended to each numeric value. When you navigate to the Data view. You will observe that the appearance of the new variables is identical to that of the original string variable, except for the alignment and the absence of the letter “a” in the measurement icon of categorical variables (nominal or ordinal).





To demonstrate that SPSS has converted the string variable to a numeric value, locate the Value Label icon in the submenu. Toggle the icon to toggle between the numerical value and its associated value descriptors. If you no longer wish to use string variables, you can either navigate to Edit and select Clear them, which deletes them, or you can choose to hide them. To conceal variables, navigate to Utilities and select Define Variable Set. This will bring up a dialogue box; enter a name for the Set Name, and then select on any variable in the bottom-left field to Display Variable Names. Select variables and select "Enter" between the two fields below to transfer them to the Variable in set box. Additionally, you can double-click the variable to expedite work (this only works when there is only one box to which the variable can be transferred and not multiple boxes). After transferring the variables, select the Add Set button and then the Close button.



Returning to the dataset, navigate to the Utilities tab once more and proceed to select the option labelled Use Variable Sets. Within the dialogue box, it becomes evident that there exist

alternatives pertaining to each of the variables as well as the newly introduced ones. Click on the option “Uncheck All” to deselect all items, and then select only the analysis set that has been recently produced. Finally, click on the “OK” button to confirm the selection. The dataset will now be limited to the selected variable for analysis. To uncover the concealed variables, please navigate back to the Utilities menu and select the option “Show All Variables.”

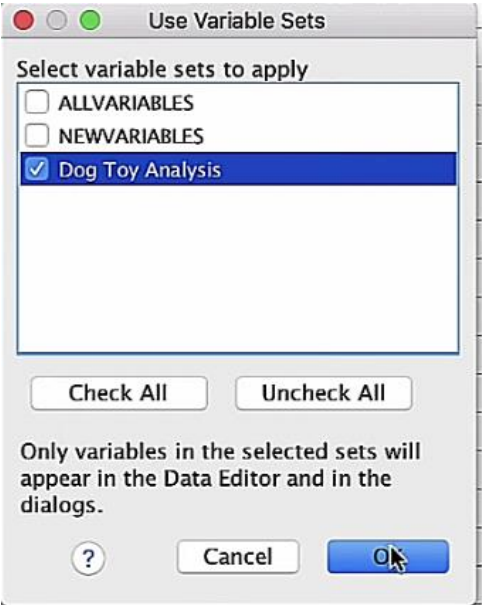
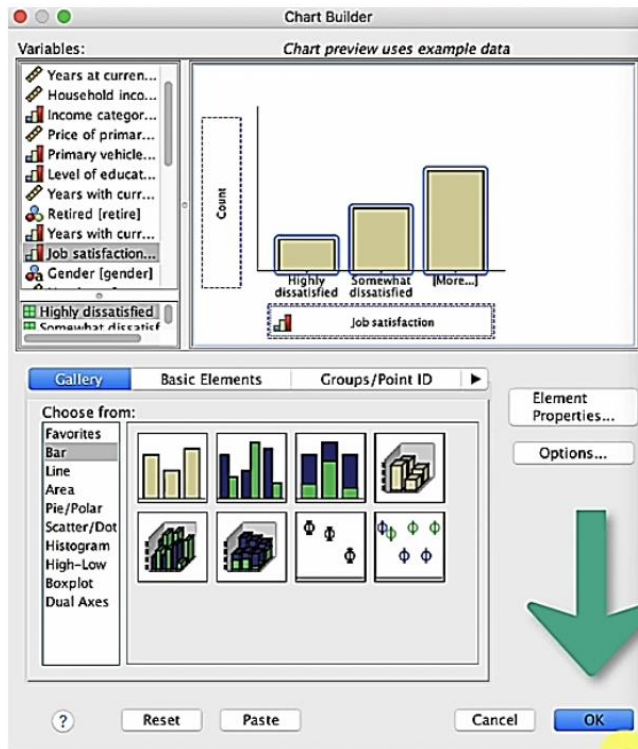


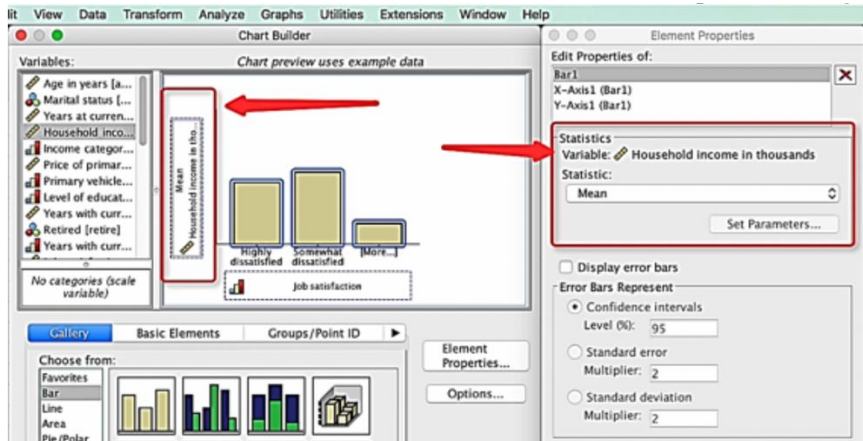
Chart Builder: The SPSS statistics software offers users various methods for generating charts, including the Frequencies command, Mean command, and Chart builder, among others. However, the chart builder has the capability to generate a chart of greater complexity. The interface consists of a dialogue box containing a canvas that provides users with a visual representation of the chart’s appearance prior to its creation. Navigate to the “Graphs” tab and select the “Chart Builder” option to access the corresponding dialogue box. When the Chart Builder dialogue box is opened, it is accompanied by an Element Properties dialogue box

which displays specific information about to the selected item on the Chart Builder dialogue box. Within the interface, there exists a series of tab options situated beneath the canvas, specifically located within the dialogue box. By default, the Bar chart is selected under the Gallery tab and can be modified by selecting a different chart with a click action. The displayed preview symbol provides users with a visual representation of the chart's appearance. By hovering over the icon, users can access the name associated with the chart icon.

To commence the chart creation process, please select a chart of your choice and drag it onto the canvas. Subsequently, the Chart Builder will generate a visual representation of the chart on the canvas, providing a preview of its appearance. However, the preview chart is currently not in a printable state, and as a result, the OK button will stay inactive. Hence, it is imperative to incorporate variables within the graph. Both the X axis and Y axis feature designated areas known as drop zones, where variables can be positioned. It is not always essential to have a variable assigned to both axes in a graphical representation. Specifically, it is possible to assign a variable just to the X axis while leaving the Y axis without a variable. In this case, the graph will depict the quantity of a specific entity inside each category represented along the X axis. When a variable is dragged into the drop zone of the X axis, the Y axis will be automatically adjusted to display the Count statistics, which will then expose the numeric figures in the Output window. It can be observed that the OK button is currently in an active state and is capable of being clicked.



Within the Variable list, it is possible to alter a variable measure to a different kind, such as changing it from a scale measure to an ordinal measure. The process can be initiated by performing a right-click action on the variable, which will prompt a menu of options to appear. From this menu, the desired measure can be selected by clicking on it. To conduct a comprehensive analysis, it is recommended that a categorical variable (either ordinal or nominal in nature) be shown on the X-axis, while a scale variable should be depicted on the Y-axis. When this action is performed, the drop zone of the Y axis is automatically set to display Mean statistics by default, and this can be observed in the Element Properties dialog box.



One might choose to click the “OK” button in order to view the actual output in the Output window. The Element attributes dialogue box provides a means to enhance a chart by enabling modifications to the attributes of different chart elements, including but not limited to the Bar Style and individual bar elements. The Statistics dropdown menu displays the various statistical options. Upon selecting any of the options followed by a question mark (?), the user gains access to the Set Parameters button located directly below the selected option. This feature enables the user to designate a specific value that will be displayed in the dataset. An additional characteristic included within the Element Properties dialogue box pertains to the presentation of error bars. Error bars are a statistical tool used to represent uncertainty in data by displaying confidence intervals around the mean. However, they can also be adjusted to depict the standard error or standard deviation. It is crucial to click the Apply button located at the bottom right corner of the Element Properties dialogue box whenever modifications are made. If one does not act, the desired modifications will not be implemented.

## **D. Analyzing data**

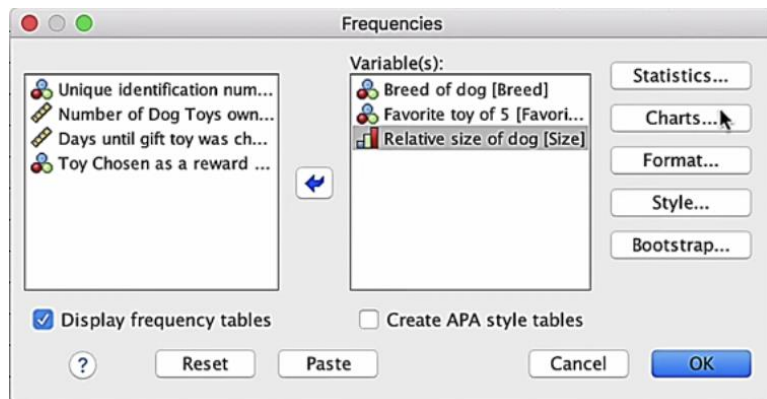
### **1. Descriptive Statistics for Categorical Data**

Data, as commonly understood, refers to the collection of numerical and information obtained through research. Data is commonly encoded using numerical values and occasionally using words or letters. When data is organized in a meaningful manner into groups, it is referred to as variables. In the context of variables, it is of utmost importance to establish a clear understanding of the purpose or significance of numerical values assigned to them. When a numerical value is used to represent names, such as a student ID number, it is referred to as a nominal number. The designation of variables as nominal data is based on their function of distinguishing across groups without implying any inherent order or magnitude. Nevertheless, if the numerical value denotes the chronological order of an event (e.g., a third visit). Therefore, it may be asserted that such a numerical value can be classified as ordinal. Ordinal data refers to numerical values that represent a specific rank or order. The variables serve to highlight distinctions within groups, particularly nominal variables, while also providing insight into the magnitude and direction of such distinctions. Nominal data lacks the ability to be compared due to its inherent dissimilarity, whereas ordinal data permits comparisons within the context of its established order or ranking. However, it is not feasible to draw comparisons among rankings.

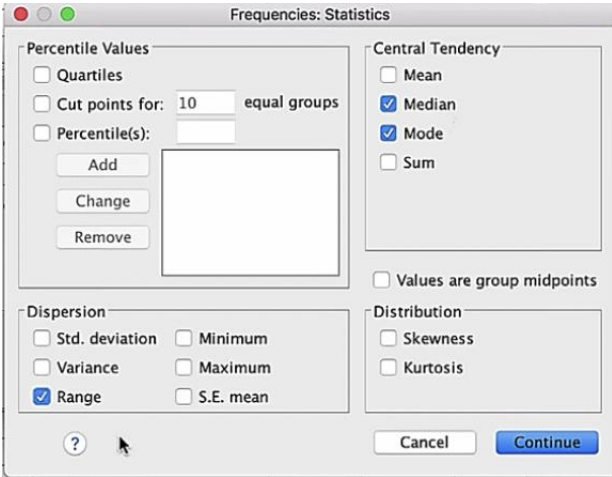
Both nominal and ordinal data can be classified as categorical data since they both involve the categorization of observations into distinct groups or categories. If the categorical variables exhibit a discernible hierarchy, they can be classified as ordinal variables. However, if the categorical variables lack a specific order, they can be classified as nominal. Both ordinal and nominal categorical data have the potential to be represented using numeric codes. Frequently, nominal data is encoded using letters or words, such as “experiment” and “control” for a research group or “F” and “M” for female and male, respectively. String variables are used to represent nominal data when it is in the form of words. String

variables can encompass numerical values, alphabetical characters, or various symbols.

There exist three primary methods for data description, including numerical representation, visual depiction through images, and tabular presentation. The data can also be represented by numerical values for measures of central tendency, such as the mean, median, and mode, as well as for measures of variability or dispersion, such as the variance, range, and standard deviation. Typically, numerical data is entered into tables, which commonly include numeric percentages and frequencies. Visual representations in the form of charts and graphs, such as bar graphs and histograms, are commonly used to depict pictorial information. In the SPSS software, all analytical procedures are performed exclusively through the Analysis menu. To access the options inside the Descriptive Statistics section, navigate to the Analysis menu and either click or hover over it. Within this submenu, the functions of Frequencies, Descriptive, and Explore are highly effective in generating precise visual representations, numerical data, or tabular displays. Crosstabs is primarily employed for the purpose of comparing two categorical variables and is particularly well-suited for conducting Chi-Square analysis. In contrast, the other options possess certain applications that do not have substantial impact in the context of analysis.



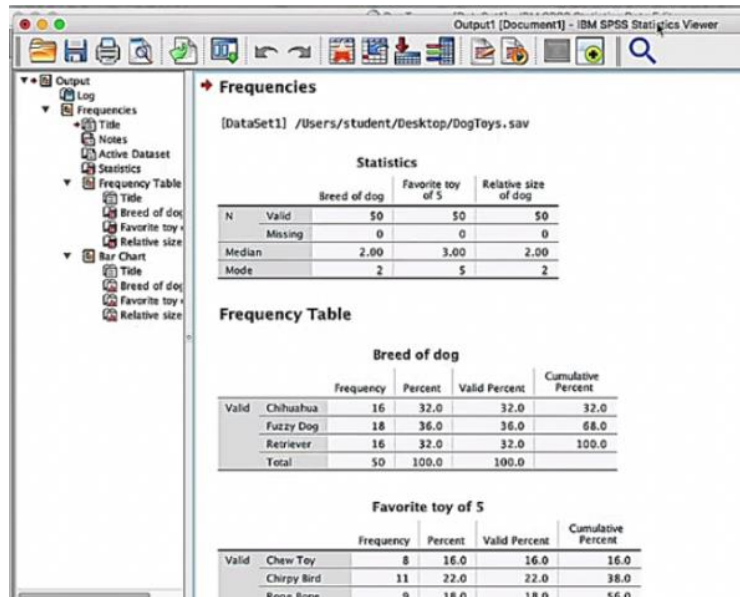
To obtain images, users can select the “Charts” option and then proceed to choose their desired chart type. The default setting for the Chart Values is Frequencies, which may be found under the Frequencies menu. To get numerical data, please navigate back to the Frequencies dialogue box and select the option labelled “Statistics.” The dialogue box that will appear presents the utilization of numeric measures in conjunction with categorical data, specifically the Mode for Nominal variables and the Median for Ordinal variables. The sole measure of dispersion applicable to categorical data is the range.



After completing the adjustments in the Frequencies menu, proceed by clicking the OK button. The resulting output will be displayed in the Output Viewer. The Statistics box will display a summary of the variable. The Median is a useful measure for evaluating ordinal data, as it represents the middle value. On the other hand, the Mode is a measure that identifies the score that occurs most frequently in a dataset. The Frequency Table is divided into four categories: Frequency, Percent, Valid Percent, and Cumulative Percent. The frequency is determined using a basic count or simple frequency calculation. In contrast, percentages offer a more convenient and efficient means of comparison and



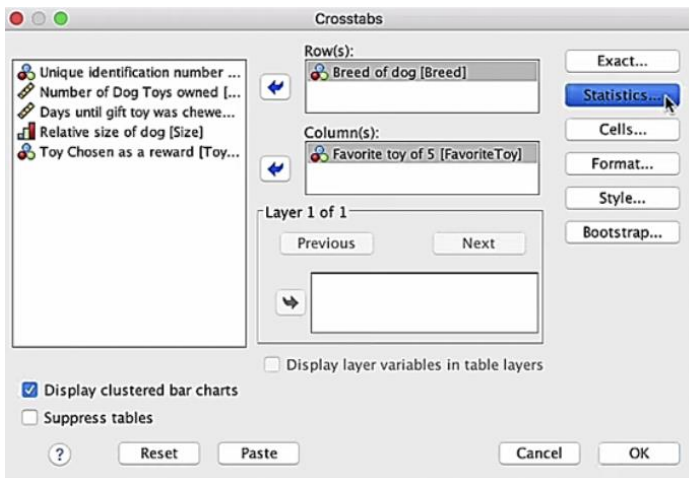
calculation when compared to mere frequency. The Valid Percent is a measure that accounts for the current data points, eliminating any missing values, in contrast to the Percent measure which includes both the existing data points and the missing values.



The concept of cumulative percent is applicable when dealing with ordered categories, but it lacks utility when applied to nominal data. However, in certain cases, it can prove to be beneficial when working with ordinal data. Utilizing a frequency table facilitates the determination of the number of categories. The provided chart visually represents the data and presents the same information as the frequency table, albeit with enhanced clarity in comparing different groups. The vertical length of the bars on the graph indicates the relative frequency or count of each group, with the highest bar being the mode for that variable.

## 2. Descriptive Statistics for Two Categorical Variables (Chi-square)

The process of merging two categorical variables in SPSS allows for the identification of patterns within the dataset. In order to accomplish this, it is necessary to employ a distinct statistical technique known as Cross-tabulation. Navigate to the “Analyze” tab, locate the “Descriptive Statistics” option, and select the “Crosstabs” function. Upon execution of this command, a dialogue box will be displayed, allowing the user to input two distinct categorical variables into designated rows and columns. The arrangement of columns and rows will produce a tabular representation that facilitates the generation of cross-tabulation. To obtain a clustered bar chart, one must select the corresponding option located in the lower left corner of the dialogue box.



Subsequently, proceed to select the “Statistics” option and ensure that the Chi-square box is checked. The chi-square test is widely employed in the analysis of categorical data, making it the most prevalent sort of statistical test for this purpose. Additionally, within the Statistics option, users have the ability to assess the measures of association, specifically Phi and Cramer’s V. To proceed, simply click on the Continue button. Return to the Crosstabs dialogue box and select the Cells option. Proceed to enable the Rows checkbox beneath the Percentages section.

Proceed by selecting the “Continue” option, and afterwards, return to the Crosstabs dialogue box and select “OK.”

The cross-tabulation table provides information on the relative frequencies or percentages of each category within a variable. In the chi-square test analysis presented, the observed significant values are found to be less than the conventional threshold of 0.05. Additionally, the number of cells with expected values below 5, a criterion for validity in this context, is satisfied.

**Breed of dog \* Favorite toy of 5 Crosstabulation**

			Favorite toy of 5					Total
			Chew Toy	Chirpy Bird	Rope Bone	Stuffed Monkey	Tennis Ball	
Breed of dog	Chihuahua	Count	5	3	5	2	1	16
		% within Breed of dog	31.3%	18.8%	31.3%	12.5%	6.3%	100.0%
	Fuzzy Dog	Count	1	6	2	7	2	18
		% within Breed of dog	5.6%	33.3%	11.1%	38.9%	11.1%	100.0%
	Retriever	Count	2	2	2	1	9	16
		% within Breed of dog	12.5%	12.5%	12.5%	6.3%	56.3%	100.0%
Total		Count	8	11	9	10	12	50
		% within Breed of dog	16.0%	22.0%	18.0%	20.0%	24.0%	100.0%

**Chi-Square Tests**

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	23.217 <sup>a</sup>	8	.003
Likelihood Ratio	22.149	8	.005
Linear-by-Linear Association	7.410	1	.006
N of Valid Cases	50		

a. 15 cells (100.0%) have expected count less than 5. The minimum expected count is 2.56.

The clustered bar chart can also be observed, wherein the categories depicted in the picture are distinctly delineated and can be consolidated into more concise and meaningful groups by means of Recoding Variables.

### 3. Descriptive Statistics for Scale Data

Scale variables or continuous data allow for the quantification of distinctions that are not discernible through category data. In the field of statistics, numerical values are employed to establish precise definitions for linguistic terms. Ordinal variables provide information about the direction and magnitude of differences,

whereas scale variables offer a more precise measurement of the number of differences. Put differently, the scale variable uses numerical values to quantify the extent of the disparity. The type of data characterized by a numerical or quantitative nature, with equal intervals between data points, is commonly referred to as scale data. This category encompasses several terms such as quantitative, numeric, or continuous data. However, they are all classified as scale data due to the presence of a consistent scale with uniform increments between the data points. There are two distinct categories of scale data that can be distinguished depending on the presence or absence of a real zero point:

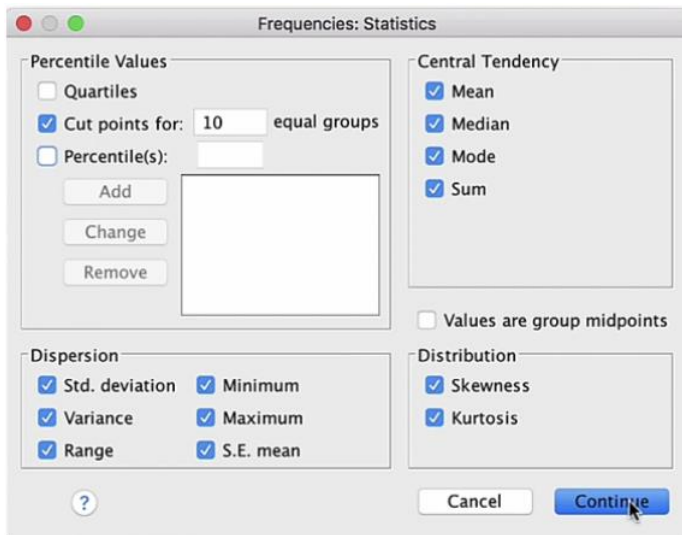
- a) Interval level data refers to scale data that lack a true 0 point, such as personality traits. Additionally, this category includes data that might have negative values, such as temperatures measured in Celsius or Fahrenheit.
- b) Ratio level data refers to scale data that include a meaningful zero point and do not include values less than zero. Examples of ratio level data include measurements such as weight, height, and Kelvin scale temperature. Ratio data is characterized by the presence of an absolute zero, which signifies a significant lack of the measured entity.

Scale data, whether interval or ratio, can be analyzed using the same statistical techniques as categorical data, such as frequency, percentages, numbers, tables, and graphs. However, there are also specialized measures available specifically for analyzing scale data. Please access your dataset and identify the scale variables, which are indicated by a ruler icon in the Measure column. These variables pertain to quantities or numerical values, answering questions such as “How much?” or “How many?” Given that each analysis requires navigating to the Analysis menu prior to using the Descriptive Statistics feature, it is possible to streamline this process by utilizing a shortcut method. To access the Descriptive Statistics feature, navigate to the Data view and perform a right-click on the variable name. This action will prompt a menu displaying various options, among which Descriptive Statistics may

be found towards the end of the list. Upon execution of this command, the Output window will be displayed, presenting a singular table that provides a comprehensive overview of the key statistical measures pertaining to the specified variable.

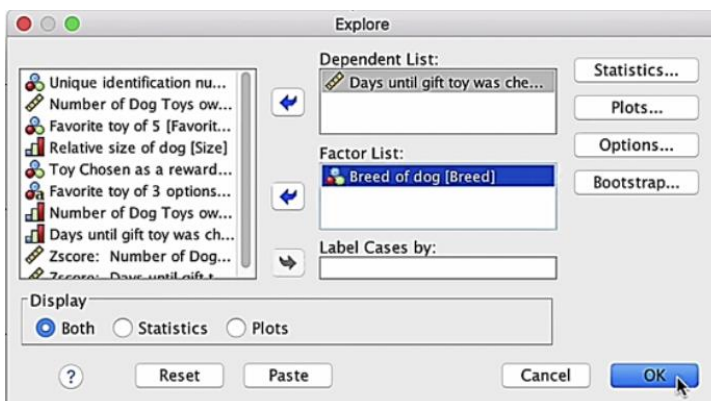
Additionally, this shortcut technique can be employed in the Variable view by right-clicking on the variable name (while holding the Shift key to select several variables). Categorical variables provide information such as the mode, range, and frequency table, whereas scale variables offer basic descriptive statistics such as the mean and standard deviation. One constraint of the shortcut technique is its lack of flexibility in selecting the specific descriptors to be included and analyzing each variable individually.

Like categorical variables, scale variables can also be represented using numbers, tables, and pictures. These visual representations can be constructed using the Frequencies menu. To access the Descriptive Statistics feature, navigate to the Analyze tab and select the Frequencies option. To transfer the scale variables to the Variable(s) box in the Frequencies dialogue box, just click on the name of the variable and then click on the “enter icon” located between the two boxes. To access the statistical settings, please navigate to the “Statistics” tab. Within this tab, you will find options to configure parameters related to central tendency (mean, median, mode, and sum), dispersion, distribution (skewness and kurtosis), and percentile values. Subsequently, proceed to select the “OK” option.

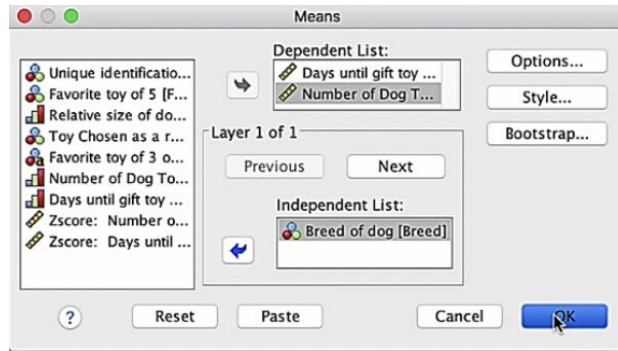


#### 4. Descriptive Statistics for Both Categorical and Scale Variable

To begin, access the Explore dialogue box and proceed to transfer the scale variable to the Dependent List box. Simultaneously, relocate the categorical variable, which may be either nominal or ordinal, to the Factor List. Finally, confirm your selections by clicking the OK button. In this manner, the scale variable has been divided by a categorical variable, and the outcome is observable in the Output viewer.



Navigate to the Analyze menu and select the Compare Means option instead of Descriptive Statistics. Proceed to choose the first option, which is Means.



The Dependent List should be populated with the scale variables, whilst the Independent List should be populated with the categorical variables (both ordinal and nominal) that are intended for comparison. To access the ANOVA table and eta box, please navigate to the Options menu and select the corresponding checkboxes. Proceed by selecting the “Continue” option and thereafter tapping the “OK” button on the Means dialogue box.

**Report**

Breed of dog		Days until gift toy was chewed up	Number of Dog Toys owned
Chihuahua	Mean	5.06	5.81
	N	16	16
	Std. Deviation	2.016	2.834
Fuzzy Dog	Mean	8.78	6.89
	N	18	18
	Std. Deviation	2.510	4.788
Retriever	Mean	13.12	5.44
	N	16	16
	Std. Deviation	3.384	3.245
Total	Mean	8.98	6.08
	N	50	50
	Std. Deviation	4.192	3.746

**ANOVA Table**

			Sum of Squares	df	Mean Square	F	Sig.
Days until gift toy was chewed up * Breed of dog	Between Groups (Combined)		521.181	2	260.591	36.044	<.001
	Within Groups		339.799	47	7.230		
	Total		860.980	49			
Number of Dog Toys owned * Breed of dog	Between Groups (Combined)		19.527	2	9.764	.687	.508
	Within Groups		668.153	47	14.216		
	Total		687.680	49			

The user's text could be rewritten as follows: "The user's text can be reformulated. The report presents the descriptive statistics for the scale variables, followed by an ANOVA table. Statistical significance in the analysis of variance (ANOVA) is conventionally determined by observing p-values that are less than 0.05. In the provided ANOVA Table, the numerical value of 0.508 in the Significance column indicates a lack of statistical significance, as it exceeds the conventional threshold of 0.05. The initial numerical value in the Significance section, specifically  $< .001$ , indicates the presence of statistical significance."

## **E. Output data**

### **1. Basic Syntax**

The Syntax window encompasses the entirety of the computer code that instructs SPSS on which analysis to execute. The analysis displayed in the Output is generated by the computer code written in SPSS syntax. In order to access the syntax window, navigate to the "Analysis" tab, proceed to select "Descriptive Statistics," and afterwards click on "Frequencies." Transfer the variables listed on the left side of the dialogue box to the designated Variable(s) on the right side. Configure the remaining choices (Statistics, Charts, Formats, Style, and Bootstrap) based on your personal preference. Additionally, please ensure that the checkbox labelled "Create APA style tables" is selected on the dialogue box. Instead of selecting the "OK" option to initiate the analysis, choose the "Paste" option. The execution of this command will result in the appearance of a distinct graphical interface referred to as the Syntax window, which contains the entirety of the computer code responsible for orchestrating the analysis procedures within the SPSS software. Additionally, on the Analyse tab, one may access the Descriptive Statistics feature and select the Explore option. Following the setup for analysis, users will find a Paste option available for further utilization. Additionally, this action will navigate you to the Syntax window.



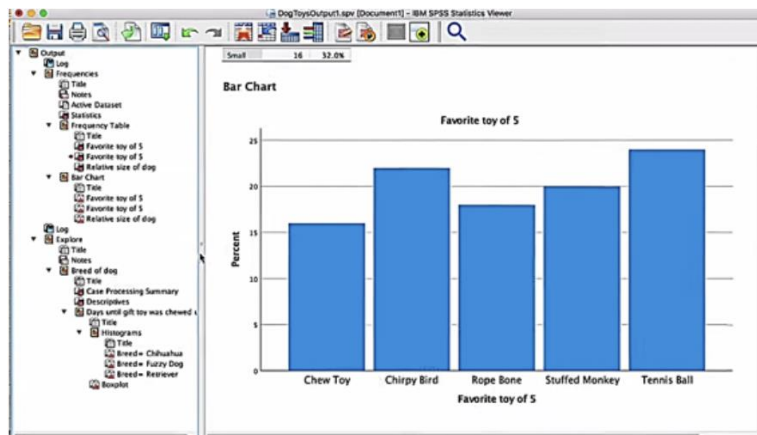
```

1 DATASET ACTIVATE DataSet1.
2
3 FREQUENCIES VARIABLES=Favorite FavoriteToy Size
4 /BARCHART PERCENT
5 /ORDER=ANALYSIS.
6
7 OUTPUT MODIFY
8 /SELECT TABLES
9 /IF COMMANDS=["Frequencies(LAST)"] SUBTYPES="Frequencies"
10 /TABLECELLS SELECT=[TOTAL] SELECTCONDITION=PARENT(VAID MISSING) APPLYTO=ROW HIDE=YES
11 /TABLECELLS SELECT=[VALID] APPLYTO=ROWHEADER UNGROUP=YES
12 /TABLECELLS SELECT=[PERCENT] SELECTDIMENSION=COLUMNS FORMAT="PCT" APPLYTO=COLUMN
13 /TABLECELLS SELECT=[COUNT] APPLYTO=COLUMNHEADER REPLACE="N"
14 /TABLECELLS SELECT=[PERCENT] APPLYTO=COLUMNHEADER REPLACE="N".
15
16 EXAMINE VARIABLES=DaysToFail BY Breed
17 /PLOT BOXPLOT HISTOGRAM
18 /COMPARE GROUPS
19 /STATISTICS DESCRIPTIVES
20 /CINTERVAL 95
21 /MISSING LISTWISE
22 /NOTOTAL.
23

```

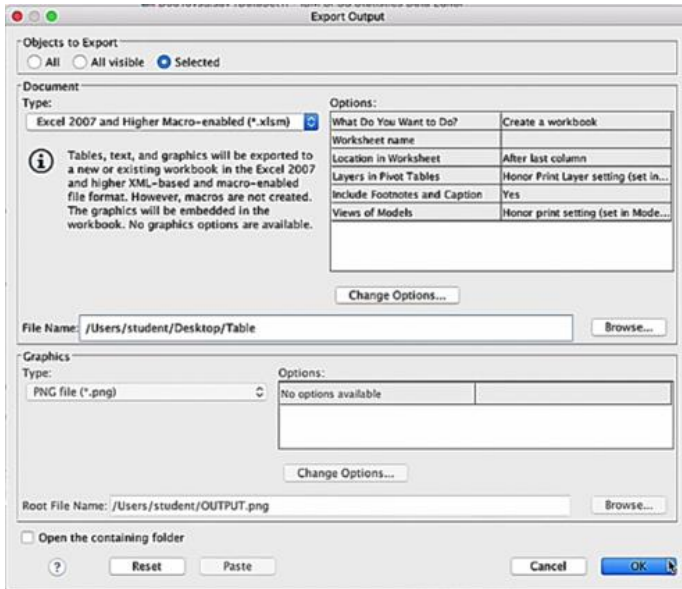
## 2. The output/viewer

The Output, referred to as the Viewer in SPSS, provides users with various options for utilizing the obtained results in other applications. The entirety of the output analysis is encompassed inside one particular window, and it is possible to scroll downwards in order to access additional analysis. The Viewer contains a tree-like outline diagram on its left column, which represents the analysis displayed in the window. By clicking on any item in the outline, the user is able to navigate straight to the relevant analysis in the window.



### 3. Export output

Regardless of the output generated in SPSS, its primary purpose is to be exported to another location for utilization in a written document. However, there may be instances where it is desirable to exclusively export a specific table or graph. To export the table or graph in the Viewer, first select its outline from the left navigation column. Next, right-click to get a pop-up menu with various options. From this menu, click on the “Export” option.



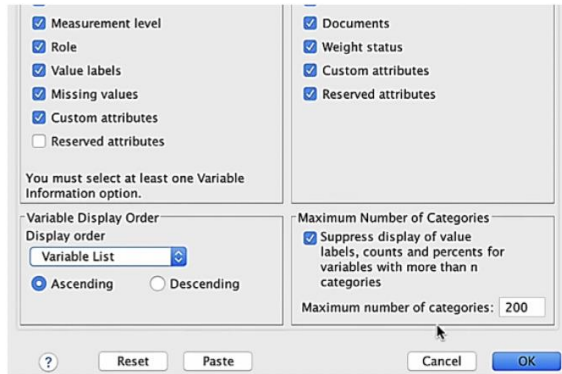
### 4. Export data

To facilitate the exportation of the dataset utilized in the study, it is necessary to activate the dataset by selecting the data window. Navigate to the “File” menu and select the option to “Export.” This will provide other statistical software solutions for utilization with the given data source. Please choose any item and choose the “Save” option from the dialogue box that will appear.

## **5. Data codebook**

The Codebook serves as a means to condense data into a format that is easily comprehensible by anyone using SPSS. The tool provides a comprehensive summary of the dictionary information, including details such as variable name, value label, missing value, variable labels, and summary statistics for the selected variables. The codebook provides a concise overview of the data, making it comprehensible to individuals who may not be familiar with the underlying procedures. The categorical variables are summarized using counts and percentages, whereas the scale variables are summarized using measures such as mean, standard deviation, and quartiles. The codebook additionally functions as a convenient means of archiving data for future reference during analysis, and it will provide guidance when revisiting the dataset to recall its contents.

To access the codebook, navigate to the “Analyse” tab, locate the “Report” section, and select the “Codebook” option. Upon execution, a Codebook dialogue box will be displayed, consisting of three tabs dedicated to the manipulation of Variables, Output, and Statistics. To transfer the variables to the Codebook Variables, please double-click on the variables in the Variable tab. The Output tab is comprised of four distinct boxes, namely the Variable Information and File Information boxes. Each of these boxes offers a variety of options for the user to choose from. The Variable Display Order, located at the bottom of the Output tab, pertains to the desired sequence in which the data should be presented. The final box is employed to control variables that exceed the number of categories specified in the smaller box below.



The Statistics tab provides users with the ability to manage the inclusion of summary statistics in the output or to completely hide the display of summary statistics. The statistical software SPSS is capable of accurately presenting a summary of statistics that is appropriate for the degree of measurement being analyzed. Once the Codebook has been established, proceed by selecting the “OK” option.

### Codebook

#### File Information

File Name	DogToys3.sav	
Location	/Users/student/Desktop	
Number of Cases	Unweighted	50
	Weighted	50

#### ToysOwned

		Value
Standard Attributes	Label	Number of Dog Toys owned
	Measurement	Scale
N	Valid	50
	Missing	0
Central Tendency and Dispersion	Mean	6.08
	Standard Deviation	3.746

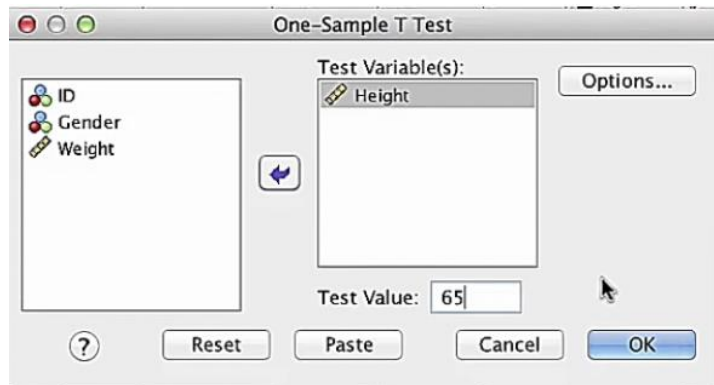
#### DaysToFail

		Value
Standard Attributes	Label	Days until gift toy was chewed up
	Measurement	Scale
N	Valid	50
	Missing	0
Central Tendency and	Mean	8.98

## A. Inferential statistics

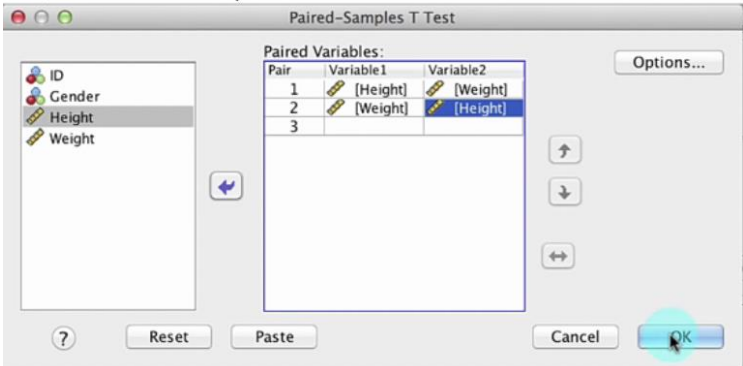
### 1. T-Test

**The One Sample T-Test** is a statistical tool commonly employed in SPSS to assess the difference between two means. For instance, this study examines the disparity in height between children who adhered to a specific dietary regimen during their formative years versus children who followed a typical diet. Consequently, the present scenario involves a cohort of individuals who have undergone prior measurements, and the objective is to utilize SPSS software to compute the average value based on this sample. Subsequently, this mean will be juxtaposed with another pre-established mean for comparative analysis. To accomplish this, it is necessary to employ a one-sample t-test. Navigate to the “Analyse” tab, locate and select the “Compare Means” option, and proceed to choose the “One Sample t-Tests” function. Upon execution, a dialogue box will be displayed in the customary manner. Subsequently, the user will be required to transfer the designated variable, such as “Height,” into the designated box labelled “Test Variable(s).” Next, input your hypothesized population mean in the designated box labelled “Test Value” and proceed by clicking the “OK” button.



**The paired-sample t-test** is employed to compare the means derived from two measurements conducted on the same sample.

The statistical analysis technique commonly referred to as the paired-sample t-test is alternatively recognized as a repeated measures design. The t-test employed in this study entails the assessment of a group on two separate occasions - once before and once after a certain treatment. The outcomes of both measurements are afterwards reported. If the scores obtained on the post-test exhibit a statistically significant increase compared to the scores obtained on the pre-test, it can be concluded that the treatment had a discernible impact. One possible approach involves conducting a weight measurement of a cohort, followed by subjecting them to a calorie-restricted diet for a duration of around one to two weeks. Subsequently, their weight is measured once again to ascertain any potential weight loss. In order to conduct a t-test, it is necessary to utilize scale variables. To access the analytical tools, navigate to the “Analyse” tab. From there, select the “Compare Means” option and proceed to choose the “Paired-Samples T-Test” function. In the dialogue box that will be displayed, navigate to the two variables that you wish to compare and designate them as the Paired Variable (multiple t-tests can be conducted). After completing the task, please proceed by clicking the “OK” button.



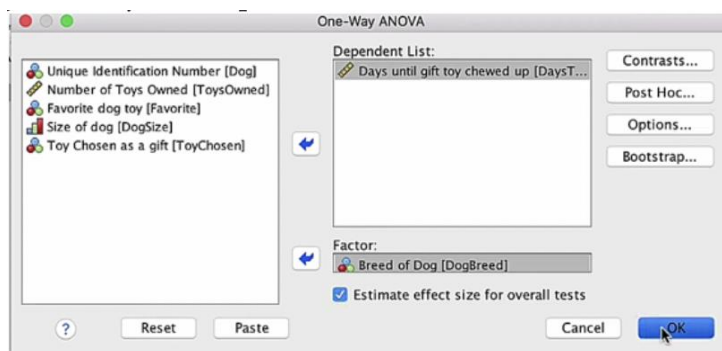
**The Independent Sample T-Test** is a statistical test that is employed to compare the means of two independent groups in

order to determine whether there is a statistically significant difference between them. In order to conduct a t-test, it is necessary to have two distinct groups, namely males and females, who are assessed based on a variable that exhibits variability, such as height. Navigate to the “Analyse” tab, locate and select the “Compare Means” option, and proceed to use the “Independent Sample T-Test” function. In the next dialogue box, transfer the variable representing measurement (referred to as the scale variable) to the designated box for test variables. Similarly, relocate the variable containing the grouping information to the designated box for grouping variables. At now, it can be observed that the OK button is rendered inactive. This is due to the requirement imposed by SPSS, which necessitates the specification of the groups to be tested in conjunction with the variable. To initiate the process, please select the Define Groups button and proceed by entering precise values to distinguish the respective groups. Proceed by selecting the “Continue” option and thereafter confirming by clicking “OK” within the first dialogue box.

## **2. One way ANOVA**

The abbreviation “ANOVA” stands for “Analysis of Variance,” and specifically, “**One-Way ANOVA**” refers to the statistical technique known as “One Way Analysis of Variance.” The data analysis technique employed to assess significant differences among three or more groups is referred to as a multiple group comparison method. The One-Way Analysis of Variance (ANOVA) is commonly known as One Way between-groups. The analysis of variance (ANOVA) involves the examination of a single independent variable, characterized by more than three levels or groups, in relation to a dependent variable that is continuous or measured on a scale. One-Way ANOVA is employed to compare the scores of three or more groups. The One-Way Analysis of Variance (ANOVA) method enables the examination of variations among distinct categories pertaining to the dependent variable.

To commence, navigate to the “Analyse” tab, proceed to select “Compare Means,” and afterwards click on “One-Way ANOVA.” In the forthcoming dialogue box, transfer the scale variable to the Dependent List box, while the categorical variable should be placed in the Factor box. In the context of ANOVA, it is not necessary to explicitly specify groups as is required in the independent sample t-test. ANOVA is capable of accommodating any number of groups that have been specified inside the factor. In order to account for the presence of more than three groups in the Factor, it is recommended to do the Post Hoc analysis and select the Tukey method. Please select the “Continue” option to return to the previous page. To proceed, please select the “Options” tab and specify the desired statistical analyses for the output, such as descriptive statistics and homogeneity of variance tests. Once the selections have been made, click on the “Continue” button to proceed. To proceed, please select the “Estimate effect size” option and then choose either the “Paste” button to access the Syntax window or the “OK” button to simply proceed to the Output.

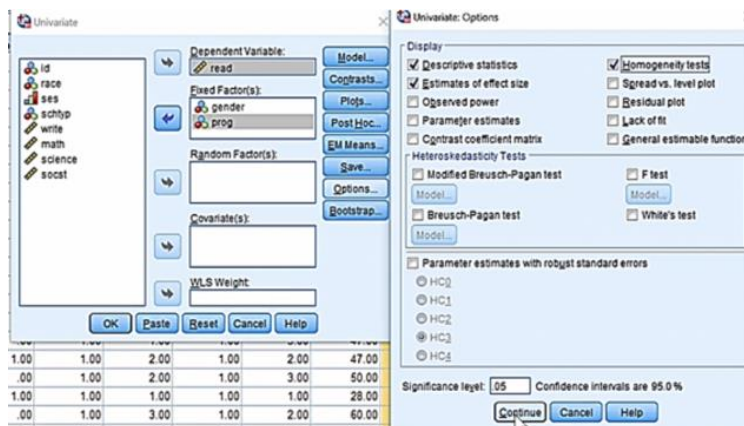


**The Two-Way Analysis of Variance (ANOVA)** is employed to examine the presence of an interaction effect between two category factors on a continuous dependent variable. The methodology employed in a Two-Way ANOVA differs from that of a one-way ANOVA. To access the General Linear Model in the software, navigate to the Analyse tab. From there, select the



Univariate option. In the forthcoming dialogue box, please relocate the continuous or scale variable to the Dependent Variable box, while transferring the categorical variables to the Fixed Factor(s) box. To access the Plots, users are advised to click on them, which will prompt the opening of a dialogue box. In this dialogue box, each categorical variable will be arranged along the Horizontal Axis and displayed as Separate Lines within the Plots. To return to the main dialogue box, please click on the “Continue” button. If any of the categorical variables contain three or more groups, please select the “Post Hoc” option to identify the specific categories that differ from each other. Then, move the variable into the designated “Post Hoc Test” box. Next, select the “Equal Variance Assumed” option, also known as the “Tukey” test, and click on “Continue”.

To access the Estimated Marginal Means, the user should navigate to the appropriate menu and select this option. Subsequently, the user should transfer the desired variables into the Display Means box. Additionally, the user should ensure that the Compare main effects box is selected. It is recommended to choose a Confident interval adjustment, preferably Bonferroni. Finally, the user should proceed by clicking the Continue button. To select the desired statistics for output display, please click on the “Options” button. Within this menu, you may choose to include various statistical measures such as descriptive statistics, estimates of effect size, and homogeneity tests. Additionally, you can specify your chosen significance level by setting it to 0.05. Please proceed by clicking the “Continue” button and then tapping “OK” in the primary dialogue box.



### 3. Correlation

The term “correlation” is derived from the combining of two linguistic elements, namely “co” which signifies “together,” and “relation” which denotes “connection.” Correlation refers to the phenomenon wherein a distinct alteration in one variable is met with a commensurate modification in another variable, either through direct or indirect means. Uncorrelated variables are characterized by the absence of a causal relationship, so that a change in one variable does not result in a predictable change in another variable. Correlation is a statistical method used to quantify the degree of association between different variables. It is capable of indicating both positive and negative relationships. When two variables exhibit a positive correlation, it indicates that an increase in one variable will lead to a corresponding increase in the other variable, and conversely, a decrease in one variable will result in a corresponding decrease in the other variable. Negative correlation refers to a scenario in which variables exhibit opposing movements, such that an increase in one variable corresponds to a drop in another variable, and vice versa. One illustrative instance of this phenomenon can be observed in the relationship between the price and demand of a certain product.

#### **4. Regression**

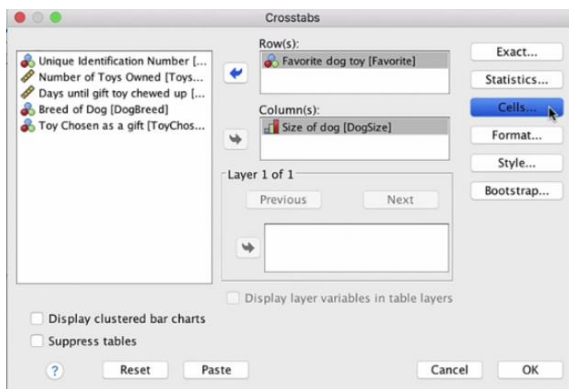
Regression is a statistical method used to quantify the degree of link between two variables, known as correlation. It is important to note that regression exhibits perfect symmetry, implying that the correlation between variables A and B is equivalent to the correlation between variables B and A. However, if the two variables are correlated, it implies that when one variable undergoes a specific change, the other variable has an average change of a particular magnitude. When the dependent variable is represented by Y and the independent variable is represented by X, this association is referred to as the regression of Y on X, and it is commonly referred to as the regression equation. In this particular situation, regression refers to the relationship where the mean value of Y is dependent on X.

Regression analysis is a statistical method used to estimate the relationship between multiple variables and forecast an outcome. In essence, regression analysis used a multitude of predictor factors to forecast the outcome of a single variable. This attribute renders it advantageous in a wide array of situations, particularly due to its applicability to individuals with regression. There exist numerous iterations and modifications of regression analysis, rendering it highly adaptable and potent in the realm of data analysis. Consequently, it has become a widely employed technique for a diverse range of analytical objectives. There exist several distinct categories of regression analysis, with five prominent forms being notable in particular.

#### **5. Chi-Square**

The Chi-Square test is employed in situations where there are two categorical variables and the objective is to determine a statistically significant difference in the interaction between these variables. To perform a chi-square analysis, navigate to the “Analyse” tab, select the “Descriptive” option, then proceed to click on “Crosstabs.” In the forthcoming dialogue box, relocate both variables individually to the designated Row(s) and Column(s). To

proceed, please navigate to the “Statistics” tab and select the Chi-Square test as the preferred hypothesis test. Additionally, ensure that both Phi and Cramer’s V are chosen as the measures of effect size. Once these selections have been made, kindly proceed by clicking on the “Continue” button.



Go to the Cells and under Percentages, select Rows and click Continue. In the Crosstabs dialog box, select the option to Display clustered bar charts and click Paste to go to the Syntax and save it or click OK to run output analysis.

## References

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## UNIT VIII

# MICROSOFT EXCEL FOR BEGINNERS

### **Learning Objectives:**

After taking this chapter, you'll be able to:

1. How to manage and prepare a workbook in Microsoft Excel
2. How to manage fill cells
3. How to apply advanced conditional formatting and filtering
4. How to create advanced formulas and macros
5. How to manage advanced charts and tables

### **A. Introduction**

Professionals are required to possess a significant proficiency in Microsoft Excel. Indeed, the possession of such aptitude can potentially lead to an opportunity for career advancement. The software is structured like a spreadsheet, comprising of vertical columns and horizontal rows. The intersection of the columns and rows in a grid is commonly referred to as a cell. According to the Corporate Finance Institute, Microsoft Excel is a suitable product for organizing and managing data effectively. The integration of columns and rows into the application enhances the organization of the data contained therein.

Hence, within the realm of professional environments, Microsoft Excel is employed for a diverse range of applications. Microsoft Excel offers a wide range of data processing formulas. The equations are frequently referred to as functions.

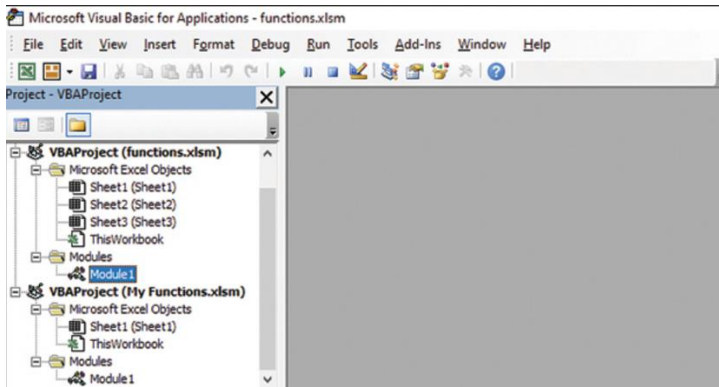
## **B. How to Manage and Prepare Workbook in Microsoft Excel**

Each Excel workbook is situated inside a broader framework of interconnected entities, encompassing macros, versions, and additional workbooks. Proficiency in workbook management entails understanding the process of establishing connections between workbooks and various other entities, as well as the ability to effectively distribute a workbook's contents across multiple users.

This UNIT provides guidance on researching techniques for enabling macros and transferring them between workbooks, overseeing workbook versions, limiting modifications to workbook content and structure, establishing options for formula computation, managing comments, and using language options.

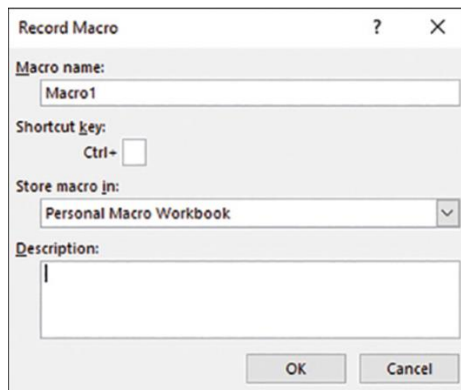
To copy a macro module from one workbook to another:

- a. Open the workbook that contains the macros you want to copy
- b. Open or create a macro-enabled workbook to which you want to copy the macros
- c. Do either of the following to open the Visual Basic Editor
- d. In the Project Explorer pane, the user is instructed to select the workbook that includes the desired macros and subsequently access the workbook's branches until the contents of the Modules folder are visible. To access the Project Explorer pane, users can either click on the "View" tab and select "Project Explorer" or use the shortcut Ctrl+R.
- e. To duplicate a module, just move the desired module to the VBAProject branch of the target workbook. The Excel software application duplicates the module, so generating the Modules branch in the target workbook if it does not already exist.



To create the Personal Macro Workbook

1. In any workbook, on the View tab, in the Macros group, click Record Macro. (Alternatively, on the Developer tab, in the Code group, click Record Macro.)
2. In the Record Macro dialog box, in the Store macro in list, click Personal Macro Workbook, and then click OK



3. Perform any task, such as selecting a cell or applying a format, and then click the Stop Recording icon in the status bar.

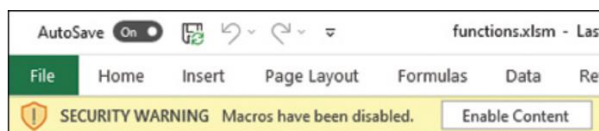
The inclusion of Microsoft Visual Basic for Applications (VBA) macros within the Office 2019 suite is regarded as highly



advantageous and influential due to its exceptional utility and formidable capabilities. Macros can be utilized to streamline repetitive processes, execute a sequence of commands efficiently through minimal user input, generate personalized Excel functions, and perform several other activities. Nevertheless, the utilization of macros also encompasses the potential for malevolent intentions, including the destruction of files, unauthorized acquisition of data, and the installation of malicious software. Consequently, when a workbook containing macros is opened, Excel automatically deactivates those macros as a default measure. At this juncture, there are three options available to you:

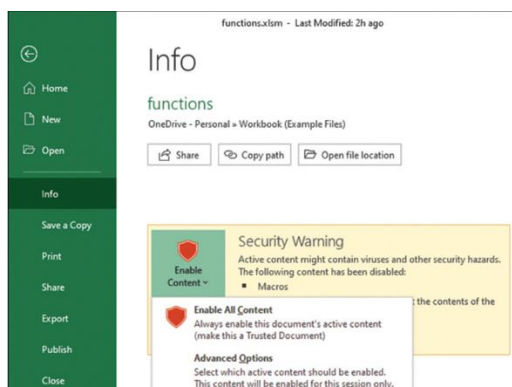
- a. If the workbook has been obtained from a reliable individual or reputable source, and its reception was anticipated, it is permissible to activate the macros.
- b. In the event that the workbook has been obtained from a reliable individual or source, but without prior anticipation, it is advisable to refrain from enabling the macros until such time as communication can be established with the originator of the workbook to ascertain whether they indeed dispatched it. In the event that the macros were activated, it is possible to enable them. Conversely, if the macros were not activated, it is advisable to keep them deactivated.
- c. It is advisable to refrain from enabling macros in the workbook if it originates from an untrusted individual or source.

When a file is opened in Excel using either the Excel Macro-Enabled Workbook (\*.xlsm) format or the Excel Macro-Enabled Template (\*.xlt) format, an information bar known as the Security Warning is displayed by Excel. This information bar serves to notify the user that the macros inside the workbook have been deactivated.



In order to activate macros in a workbook that presents the Security Warning information bar, users should click on the “Enable Content” option if they have confidence in the workbook’s trustworthiness. Alternatively, they can choose to exit the information bar, which will result in the macros remaining deactivated.

To activate macros in a workbook subsequent to closing the Security Warning information box, one must navigate to the File tab, proceed to the Info page, locate and select the Enable Content button, and subsequently choose the option to Enable All Content.



## Reference data in another workbook

To establish a connection between two workbooks, one can utilize a linking mechanism when there is a need to access data from one worksheet in another. This functionality allows users to incorporate references to cells or ranges in a separate worksheet into their formulas. Excel has the capability to automatically update the link when there are changes in the other data. Links are established by generating an external reference to a cell or range within a separate workbook. The workbook housing the external reference is commonly referred to as the dependent workbook, sometimes known as the client workbook. The workbook housing the primary data is sometimes referred to as the source workbook, also known as the server worksheet.

If one possesses knowledge regarding the organization of an external reference, it is also possible to manually create such references by employing the subsequent syntax:

*'path[workbookname]sheetname'!reference*

The subsequent enumeration delineates the arguments:

- a. The term “path” refers to a route or course that is taken to reach a particular. The location of the workbook, denoted by the drive and directory, may be specified as a local path, a network path, or an Internet address. The inclusion of the path is necessary solely when the workbook is in a closed state.
- b. The title of the workbook is “Workbook Name.” The workbook’s title, encompassing the file extension. It is recommended to consistently utilize square brackets ([ ]) when indicating the name of a workbook.
- c. The term “sheetname” refers to the name given to a specific sheet or tab within
- d. The worksheet tab that includes the referenced cell is referred to as the name of the worksheet tab. Please provide more context or specify what you would like me to reference. A cell or range reference, or a defined name is required in this context.

To create a link that references data in another workbook

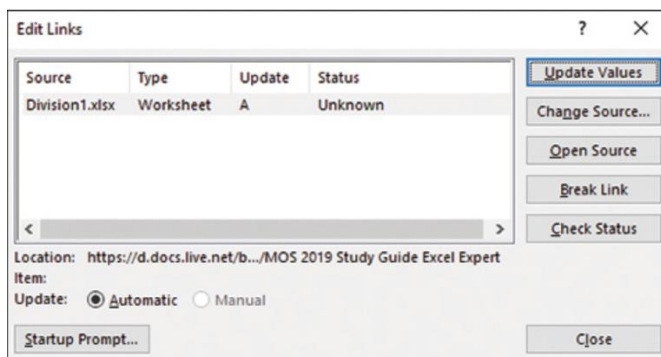
- a. Access the source workbook that contains the data to be referenced.
- b. In the worksheet that is dependent on another workbook, initiate a formula and conclude it at the desired location where the external reference is intended to be displayed.
- c. To access the source workbook, navigate to the View tab and locate the Window group. Within this group, select the Switch Windows option and choose the desired source workbook.
- d. To reference a specific cell in your formula, please navigate to the source workbook and select the desired cell. The external reference is inserted into the formula by Excel.
- e. Please finalize the formula and thereafter press the Enter key.

The screenshot shows an Excel spreadsheet with a linked formula in cell A3: `=[Division1.xlsx]Sales!$N$3`. The formula bar displays this link. Below, a table shows sales data for three teams across months from May to December, with a 'Totals' column. The data is as follows:

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Team 1	25,000	25,400	26,000	24,000	24,000	26,000	24,000	24,000	294,000
Team 2	30,500	30,000	31,000	29,500	29,500	32,000	29,500	29,500	358,550
Team 3	27,000	26,750	27,000	25,250	25,250	28,000	25,250	25,250	310,000

### To update a link

- First, proceed to open the workbook that is dependent. When the source workbook is open at the time of performing the action, Excel will immediately update the link.
- Please proceed to open the workbook that is dependent. When the source worksheet is not open, Excel presents a security notification in the information bar, informing the user that the automatic updating of links has been off. Please select the “Enable Content” option.
- To access the Edit Links feature, navigate to the Data tab and locate the Queries & Connections group. From there, click on the Edit Links option. In the opened Edit Links dialogue box, proceed to select the desired link and subsequently click on the option labelled “Update Values”.



### C. How to Manage Fill Cells

When seeing workbooks inherited from others or imported data from other sources, it is common to encounter data that is either structured or formatted in a manner that presents challenges in terms of readability or usability. The potential instances of data irregularities include the presence of mainframe data in uppercase characters, dates in non-standard forms, phone numbers without dashes or brackets, and fields amalgamating various data components, such as first names and last names.

One potential approach to address this data is to manually input it into the desired or necessary structure or format. While this approach may be effective for a limited number of records, it becomes laborious and time-intensive when dealing with a larger volume of records, and ultimately becomes impractical when handling hundreds or even thousands of records.

Fortunately, the process of generating desired data from pre-existing data may frequently be accomplished with minimal effort due to the availability of a tool in Microsoft Excel known as Flash Fill. When presented with a column of initial data, one can utilize the first cell in the subsequent column to input the rectified data. This rectified data may either be extracted from the original cell or formatted differently while remaining the same. By selecting the second cell and executing the Flash Fill command, Excel is capable of discerning the user's intention and proceeds to automatically populate the remaining cells in the column with the corrected data.

	A	B	A	B
1	Company (Upper)	Company	Company (Upper)	Company
2	B'S BEVERAGES	B's Beverages	B'S BEVERAGES	B's Beverages
3	ISLAND TRADING	Island Trading	ISLAND TRADING	Island Trading
4	SPLIT RAIL BEER & ALE		SPLIT RAIL BEER & ALE	Split Rail Beer & Ale
5	CONSOLIDATED HOLDINGS		CONSOLIDATED HOLDINGS	Consolidated Holdings
6	EASTERN CONNECTION		EASTERN CONNECTION	Eastern Connection
7	AROUND THE HORN		AROUND THE HORN	Around The Horn
8	WHITE CLOVER MARKETS		WHITE CLOVER MARKETS	White Clover Markets
9	QUICK-STOP		QUICK-STOP	Quick-Stop
10	SEVEN SEAS IMPORTS		SEVEN SEAS IMPORTS	Seven Seas Imports
11	HUNGRY COYOTE IMPORT STORE		HUNGRY COYOTE IMPORT STORE	Hungry Coyote Import Store
12	BOTTOM-DOLLAR MARKETS		BOTTOM-DOLLAR MARKETS	Bottom-Dollar Markets
13	HUNGRY OWL ALL-NIGHT GROCERS		HUNGRY OWL ALL-NIGHT GROCERS	Hungry Owl All-Night Grocers
14	TRAIL'S HEAD GOURMET PROVISIONERS		TRAIL'S HEAD GOURMET PROVISIONERS	Trail's Head Gourmet Provisioners
15	THE BIG CHEESE		THE BIG CHEESE	The Big Cheese
16	SAVE-A-LOT MARKETS		SAVE-A-LOT MARKETS	Save-A-Lot Markets
17	OLD WORLD DELICATESSEN		OLD WORLD DELICATESSEN	Old World Delicatessen
18	GREAT LAKES FOOD MARKET		GREAT LAKES FOOD MARKET	Great Lakes Food Market
19	LAZY K KOUNTRY STORE		LAZY K KOUNTRY STORE	Lazy K Kountry Store
20	LAUGHING BACCHUS WINE CELLARS		LAUGHING BACCHUS WINE CELLARS	Laughing Bacchus Wine Cellars
21	CHOP-SUEY CHINESE		CHOP-SUEY CHINESE	Chop-Suey Chinese
22	LONESOME PINE RESTAURANT		LONESOME PINE RESTAURANT	Lonesome Pine Restaurant
23	RATTLESNAKE CANYON GROCERY		RATTLESNAKE CANYON GROCERY	Rattlesnake Canyon Grocery
24	THE CRACKER BOX		THE CRACKER BOX	The Cracker Box

Column A contains a list of all-uppercase company names. In column B, I use cell B2 to type the title-case version of the text in cell A2 and then select cell B3. After I run the Flash Fill command, Excel recognizes the pattern and fills in the rest of the column with title-case versions of all the other cells in column A.

Column A consists of a series of complete names, with each cell containing the first name, middle initial, and last name. The first name, middle initial, and last name from cell A2 were entered into cells B2, C2, and D2, accordingly. Upon picking cell B3 and executing the Flash Fill function in Excel, the software aptly identifies the underlying pattern and proceeds to automatically populate the remaining first names. Likewise, upon selecting cell C3 and executing Flash Fill, the programmed intelligently appends the middle initials, while selecting D3 and running Flash Fill accomplishes the task of appending the last names.

	A	B	C	D	A	B	C	D
1	<b>Full Name</b>	<b>First Name</b>	<b>Initial</b>	<b>Last Name</b>	<b>Full Name</b>	<b>First Name</b>	<b>Initial</b>	<b>Last Name</b>
2	Maria Z. Anders	Maria	Z.	Anders	Maria Z. Anders	Maria	Z.	Anders
3	Victoria T. Ashworth				Victoria T. Ashworth	Victoria	T.	Ashworth
4	Helen K. Bennett				Helen K. Bennett	Helen	K.	Bennett
5	Christina C. Berglund				Christina C. Berglund	Christina	C.	Berglund
6	Marie X. Bertrand				Marie X. Bertrand	Marie	X.	Bertrand
7	Elizabeth G. Brown				Elizabeth G. Brown	Elizabeth	G.	Brown
8	Phillip Z. Cramer				Phillip Z. Cramer	Phillip	Z.	Cramer
9	Simon W. Crowther				Simon W. Crowther	Simon	W.	Crowther
10	Ann G. Devon				Ann G. Devon	Ann	G.	Devon
11	Catherine Q. Dewey				Catherine Q. Dewey	Catherine	Q.	Dewey
12	Peter Y. Franken				Peter Y. Franken	Peter	Y.	Franken
13	Thomas V. Hardy				Thomas V. Hardy	Thomas	V.	Hardy
14	Paul M. Henriot				Paul M. Henriot	Paul	M.	Henriot
15	Michael C. Holz				Michael C. Holz	Michael	C.	Holz
16	Janine S. Labrune				Janine S. Labrune	Janine	S.	Labrune
17	Maria A. Larsson				Maria A. Larsson	Maria	A.	Larsson
18	Yoshi N. Latimer				Yoshi N. Latimer	Yoshi	N.	Latimer
19	Elizabeth J. Lincoln				Elizabeth J. Lincoln	Elizabeth	J.	Lincoln
20	Patricia D. McKenna				Patricia D. McKenna	Patricia	D.	McKenna
21	Roland U. Mendel				Roland U. Mendel	Roland	U.	Mendel
22	Liz W. Nixon				Liz W. Nixon	Liz	W.	Nixon
23	Rene M. Phillips				Rene M. Phillips	Rene	M.	Phillips
24	John V. Steel				John V. Steel	John	V.	Steel

Column A consists of a series of telephone numbers that do not include any brackets or dashes. The phone number from cell A2 was entered into cell B2, with the inclusion of brackets and a dash. Upon selecting cell B3 and executing the Flash Fill function, Excel aptly identifies the underlying pattern and proceeds to populate the remaining cells in the column with the appropriately formatted phone numbers.

	A	B	A	B
1	<b>Phone 1</b>	<b>Phone 2</b>	<b>Phone 1</b>	<b>Phone 2</b>
2	3175557605	(317) 555-7605	3175557605	(317) 555-7605
3	3175559281		3175559281	(317) 555-9281
4	3175551452		3175551452	(317) 555-1452
5	3175555016		3175555016	(317) 555-5016
6	3175556433		3175556433	(317) 555-6433
7	3175559709		3175559709	(317) 555-9709
8	3175551890		3175551890	(317) 555-1890
9	3175559392		3175559392	(317) 555-9392
10	3175555877		3175555877	(317) 555-5877
11	3175554733		3175554733	(317) 555-4733
12	3175555123		3175555123	(317) 555-5123
13	3175551166		3175551166	(317) 555-1166
14	3175559826		3175559826	(317) 555-9826
15	3175555420		3175555420	(317) 555-5420
16	3175552765		3175552765	(317) 555-2765
17	3175557767		3175557767	(317) 555-7767
18	3175553038		3175553038	(317) 555-3038
19	3175555745		3175555745	(317) 555-5745
20	3175554453		3175554453	(317) 555-4453
21	3175558220		3175558220	(317) 555-8220
22	3175551191		3175551191	(317) 555-1191
23	3175559642		3175559642	(317) 555-9642
24	3175559113		3175559113	(317) 555-9113

The following table lists the special symbols you use to define each of these parts:

Symbol	Description
#	The device reserves a position for a numerical digit and accurately presents the digit in the same format as it was entered. If no number is entered, the display remains empty. As an illustration, when a cell's custom format is set to "####" and the value 25 is entered into the cell, Excel will exhibit the value as "25".
0	The device reserves a position for a numerical symbol and accurately presents the symbol in the same format it was entered. The output will be 0 if no numerical value is provided. As an illustration, when a cell's custom format is set to "000" and the user inputs the value of 25 into the cell, Excel will exhibit the value as "025".
?	The device reserves a position for a numerical symbol and accurately presents the symbol in the same format it was inputted. If no number is entered, a blank space is displayed. As an illustration, when a cell's custom format is set as 0???, and the user inputs the value 25 into the cell, Excel will exhibit the output as "0 25".

Symbol	Description
. (period)	This function is used to establish the placement of the decimal point. For instance, when a cell's custom format is set to #.#0 and the user inputs the value 34.5 into the cell, Excel will present the value as 34.50
, (comma)	This function is responsible for determining the placement of the thousand's separator. The marking solely pertains to the position of the initial one thousand. As an illustration, when a cell's custom format is set to #,### and the value 12345 is entered into the cell, Microsoft Excel will present the value as "12,345"
%	The value is multiplied by a factor of 100 solely for the purpose of visual representation, and thereafter appended with the symbol denoting percentage (%). As an illustration, when a cell's custom format is set to #% and the user inputs .75 into the cell, Excel will exhibit the value as 75%.
E+ e+ E- e-	The numerical value is presented in scientific notation. The symbols "E-" and "e-" are used to indicate a negative sign in the exponent, whereas "E+" and "e+" are used to indicate a positive sign in the exponent. As an illustration, when a cell's custom format is set to 0.00E+00 and the value 123456789 is entered into the cell, Microsoft Excel will present the value as 1.23E+08. In a similar vein, when a cell's custom format is set to 0.0E-00 and the user inputs the value 0.0000012 into the cell, Excel will exhibit the output as 1.2E-06.
/ (slash)	This function is used to specify the placement of the fraction separator. As an illustration, when a cell is formatted with the custom format "0/0" and the value ".75" is entered into the cell, Microsoft Excel will exhibit the output as "3/4".
\$ ( ) : - + <space>	This statement showcases the character. As an illustration, when a cell in Excel is formatted as \$##0.00 and the value 123.5 is entered into the cell, the software will exhibit the value as \$123.50.
*	The process involves duplicating the character that immediately precedes the asterisk until the entire cell is occupied. The replacement of symbols or numerals is not undertaken. An instance of a dot trailer within a cell can be achieved by appending the asterisk symbol (*) to the formatting. When the custom format in Excel is set as "#* .", and the user enters the value "123" into a cell, the software will display "123" followed by a series of dots that continue until the cell is completely filled.



Symbol	Description
_ (underscore)	The action of inserting a blank space with a width equivalent to the character that succeeds the underscore is frequently employed to facilitate the alignment of numerical values. An illustration of this is the utilization of the custom format _(#.00, which results in the inclusion of a vacant space equivalent to the width of the opening parenthesis at the commencement of the exhibited value.
\ (backslash)	The function inserts the character that immediately follows the backslash. Please refer to the following item for an illustrative example. In a general context, the utilization of the backslash is primarily restricted to reserved characters (e.g., # or @) or specific letters, namely B, D, E, G, H, M, N, S, and Y. In the case of all other letters, if a single character is entered, Excel will display that character. For instance, when a cell in Excel is formatted as #.##\M and the user inputs the value 1.23, the software will exhibit the value as 1.23M.
"text"	The user is requesting to include the text enclosed within the quotation marks. As an illustration, when a cell in Excel is formatted with the custom format "Part "\#00-0000 and the value 123456 is entered into the cell, the software will exhibit the value as Part #12-3456.
@	This function exhibits the textual content of the cell. As an illustration, when a cell's custom format is set as "@' entry" and the user inputs the term "credit" into the cell, the Excel software will exhibit the text "credit entry" on the display.
[color]	This function exhibits the cellular contents in the designated color. An illustration of this may be seen when the cell's custom format is set as [green]0.00; [red]0.00. In this case, Excel will exhibit positive values in the cell as green and negative values as red. The available color options are black, white, red, green, blue, yellow, magenta, cyan, as well as the color codes color1 through color565.

To access the Format Cells dialog box, you may choose one of the following options:

- a. To access the formatting options for cells, navigate to the Home tab and locate the Cells group. Within this group, click on the Format button, followed by selecting the Format Cells option.

- b. To format cells or a range, please perform the following steps: first, right-click on the desired cell or range, and then select the “Format Cells” option.

To execute the desired command, please press the Ctrl key and simultaneously press the number 1 key on your keyboard.

- a. To generate and implement a personalized numerical format, it is necessary to follow a specific set of steps.
- b. Please designate the cell or range of cells to which you wish to apply the desired formatting.
- c. Access the Format Cells dialogue box. Navigate to the Number tab and select the Custom option from the Category list.
- d. To establish the custom number format by utilizing an already existing format, the user should select the base format from the Type list.
- e. Please revise or input the symbols that establish the numerical format.
- f. When you are done, click OK to return to the worksheet.

#### **D. How to Apply Advance Conditional Formatting and Filtering**

A significant number of Excel worksheets often consist of a large quantity of data values. The comprehension of extensive datasets can be achieved by the utilization of formulas, the application of functions, and the execution of data analysis techniques. Nevertheless, there are instances in which one may not desire to engage in the analysis of a specific worksheet, per se.

Excel includes an additional component for conditional formatting, which enhances the functionality of this feature. Specifically, users have the ability to apply conditional formatting based on the outcomes of a calculation. One can establish a logical formula as the requirement for conditional formatting. When the formula evaluates to TRUE, Excel will apply the formatting to the cells. Conversely, if the formula evaluates to FALSE, Excel will not apply the formatting.

In the context of a conditional formatting rule, it is customary to establish a logical formula that compares a desired value with a specific value from a range of values. To facilitate the comparison of all values in the range with the target value, a mixed-reference format is typically employed for the specific value in question. For instance, consider a dataset with a series of percentage increments within the range D5:D13, alongside a designated “target” percentage value stored in cell D2. The objective is to implement a formatting scheme exclusively for entries in which the percentage increase is equal to or exceeds the specified target number. The following is the logical formula to be utilized:

`=D5 >= D$2`

The mixed-reference format `D$5` is utilized in Excel to maintain the fixed column (D) while allowing the row number to vary (specifically, from 5 through 13). In each instance, the resulting cell value is compared with the value in `D$2`.

In order to generate a personalized conditional formatting rule utilizing a formula:

- a. Please indicate the desired range for the use of the custom conditional formatting.
- b. Within the dialogue box labelled “New Formatting Rule,” navigate to the list titled “Select a Rule Type” and proceed to select the option labelled “Use a formula to determine which cells to format.
- c. Please input your logical formula in the designated area labelled “Format values where this formula is true.
- d. To access the Format Cells dialogue box, please click on the Format option.
- e. In the tabs labelled Number, Font, Border, and Fill, please indicate the desired formatting that you would like Excel to apply when the formula evaluates to TRUE. Once you have specified the formatting, kindly click on the OK button.
- f. To proceed, please select the “OK” option in the New Formatting Rule dialogue box.

In order to modify a conditional formatting rule, one must follow a specific set of steps:

- a. Please select any cell within the specified range that has the conditional formatting applied.
- b. To access the Conditional Formatting Rules Manager dialogue box, navigate to the Conditional Formatting menu and select the option “Manage Rules”.
- c. To alter a specific rule, please choose the desired rule and proceed to click on the “Edit Rule” option. This action will prompt the opening of the “Edit Formatting Rule” dialogue box.
- d. To implement modifications to the rule type, rule conditions, or rule formatting, please proceed by making the necessary adjustments and thereafter clicking on the “OK” button.
- e. Click “OK” in the Edit Formatting Rule dialogue box.
- f. Click the “OK” button in the dialogue box for the Conditional Formatting Rules Manager.

In order to modify the sequence in which conditional formatting rules are executed, one must follow a specific procedure:

- a. Select any cell within the specified range that has the conditional formatting feature enabled.
- b. Access the dialogue box for managing Conditional Formatting Rules.
- c. To modify the position of a rule, select the desired rule and subsequently select either the upward or downward arrow until the rule is situated in the preferred position.
- d. Please proceed to replicate the aforementioned steps for any other rules you wish to transfer, and thereafter select the “OK” option.

In order to remove a conditional formatting rule, one must follow the steps outlined below:

- a. Select any cell within the specified range that has the conditional formatting feature enabled.

- b. Access the dialogue box for managing Conditional Formatting Rules.
- c. To remove a specific rule, please choose the rule you wish to eliminate and thereafter click on the option labelled “Delete Rule”. The rule is eliminated by Excel.
- d. Please select the “OK” option in order to clear the dialogue window and navigate back to the worksheet.

### **E. How to Create Advance Formulas and Macros**

While Excel is effective as a basic database, it is often necessary to do tasks beyond just data storage in most worksheets. In addition, it is imperative to condense the data, employ statistical methodologies, do data analysis, automate processes through macros, and utilize other strategies to scrutinize the data within your worksheet. These actions will enable you to derive pertinent conclusions aligned with your business needs. The achievement of such a high degree of dynamism necessitates the development of worksheet models that incorporate formulas, functions, and macros. To incorporate a function within a mathematical expression:

- a. Please input the formula until the desired location for inserting the function.
- b. To access the desired function, navigate to the Formulas tab and locate the Function Library group. Within this group, select the category that encompasses the specific function you intend to utilize. Next, navigate to the category menu and select the function option.
- c. To input the function arguments, please proceed to the Function Arguments dialogue box and thereafter click on the OK button.

In the realm of computer science, the term “intelligence” is often employed in a broad sense to refer to systems that possess the capability to conduct assessments on their surroundings and subsequently respond based on the outcomes of those assessments. Nevertheless, it is important to note that a computer operates on a binary system, so restricting its ability to respond to a

test's outcome in only two possible ways. Despite the constrained selection of choices available, it is still possible to incorporate a substantial amount of intellectual prowess into your worksheets. The formulas have the capability to evaluate the values included within cells and ranges, subsequently generating outcomes based on these evaluations. The utilization of logical functions in Excel is employed for the purpose of constructing formulas that facilitate decision-making processes.

The subsequent table provides a description of the prevailing logical functions:

<b>Function</b>	<b>Description</b>
IF(logical_test , value_if_true [, value_if_false ])	Performs a logical test and returns a value based on the result.
AND(logical1 [, logical2 ,...])	Returns TRUE if all the arguments are true
OR(logical1 [, logical2 ,...])	Returns TRUE if any argument is true
NOT(logical )	Reverses the logical value of the argument

Nesting a single IF function within another is a useful technique for doing many logical tests. However, as the level of nesting increases to three or more IF functions, the approach becomes cumbersome and challenging to interpret. If the data analysis necessitates the utilization of more than two logical tests, one can enhance the readability of the worksheet model by employing the IFS function.

IFS(logical\_test1, value\_if\_true1, [logical\_test2, value\_if\_true2,...])

The IFS function is comprised of a sequence of logical tests, each of which is accompanied by a corresponding return value. The IFS function sequentially evaluates each logical test and returns the corresponding result of the first logical test that evaluates to TRUE.

**Perform logical operations with criteria**

The SUM, AVERAGE, and COUNT functions in Excel are utilized to calculate the total value, mean value, and count of data, correspondingly, inside a designated range. These functions are

applicable to the full range, however, it is frequently necessary to calculate the sum, average, or count of only those cells that satisfy a specific condition. As an illustration, one may be interested in obtaining the aggregate sales figures exclusively for the clientele originating from the United States. The utilization of several criteria enables the execution of even more advanced calculations. As an illustration, one may be interested in obtaining the aggregate sales figures for clients who both reside in the United States and are situated in the state of Oregon.

These tasks appear to necessitate intricate arrangements of the IF, AND, and OR functions nested within the SUM, AVERAGE, or COUNT function. Fortunately, Microsoft Excel incorporates three summary functions, namely SUMIF, AVERAGEIF, and COUNTIF, which allow users to specify various criteria without resorting to intricate nesting. In each instance, the use of the term “IF” within the function name suggests that an IF function is inherently incorporated within each respective function, without requiring explicit invocation.

The SUMIF function has resemblance to the SUM function, with the exception that it exclusively totals the values of cells inside a given range that satisfy a predetermined condition:

`SUMIF(range, criteria[, sum_range])`

In this context, the range argument refers to the range of cells that will be utilized for the criteria. The criterion argument, entered as text, represents the specific conditions that Excel employs on the range in order to identify the cells that will be summed. Additionally, the sum\_range argument is an optional parameter that designates the range from which the values to be summed are extracted. The Excel function “SUMIFS” calculates the sum of values in the “sum\_range” that satisfy the specified criteria and correspond to the cells in the “range”. In the event that the sum\_range is omitted, Excel will default to using the range for the summation.

In the context of constructing a criteria argument, it is customary to adhere to the subsequent structure:

The term “operator value” refers to the numerical result obtained when an operator is applied to a given set of values or variables.

In this context, the operator can be substituted with a comparison operator, such as the equal to (=) operator or the greater than (>) operator. Similarly, the value can be replaced with a comparison value. Several Excel functions also include support for text-only criteria arguments, which can optionally utilize one or more wildcard characters. The asterisk (\*) is used to match any number of characters, while the question mark (?) is used to match any single character.

The COUNTIF function is utilized to determine the quantity of cells within a specified range that satisfy a singular condition.

The COUNTIF function is a built-in function in spreadsheet software that allows users to count the number of cells within a specified range that

In this context, the term “range” should be substituted with the specific range of cells that will be utilized for the counting operation. Similarly, the phrase “criteria” should be replaced with the criteria, expressed as textual input, which Excel employs to identify the cells inside the range that will be included in the count.

The AVERAGEIF function calculates the average of a range set for those items that meet a specified condition:

AVERAGEIF(range, criteria[, average\_range])

### **Perform logical operations with multiple ranges and criteria**

The preceding part elucidates the utilization of the SUMIF, COUNTIF, and AVERAGEIF functions, which serve to supplant intricate nested functions by condensing them into a solitary condition. Nevertheless, there are numerous scenarios in which the logical formula necessitates the application of various criteria to different ranges. In order to address these scenarios, Excel incorporates five summary functions that can be employed to delineate various criteria: SUMIFS, AVERAGEIFS, COUNTIFS, MAXIFS, and MINIFS. In each instance, the use of the acronym



“IFS” within the function name suggests that several IF functions are inherently incorporated within each function, without requiring explicit invocation.

The SUMIFS function calculates the sum of cells inside a specified range that align with cells in one or more ranges, based on one or more specified criteria.

The SUMIFS function is a built-in function in spreadsheet software that allows users to calculate the sum of a range of values based on several criteria. It takes several arguments, including the sum\_range, which is the range of cells to be summed, and one or more pairs of range and criterion

The sum\_range parameter refers to the range of variables from which the summation is performed. The Excel function “SUMIFS” calculates the sum of values in a specified range, considering only the cells that satisfy the specified conditions. The range1 parameter represents the initial range of cells to be utilized for the summation criteria, whereas the criteria1 parameter denotes the initial criterion, inputted as text, that establishes which cells are to be summed. The criterion is applied by Excel to range1. The maximum number of range/criterion pairs that can be entered is 127.

The MAXIFS function is utilized to retrieve the highest value within a specified range, based on certain conditions being met in one or many ranges.

MAXIFS(max\_range, range1, criteria1[, range2, criteria2, ...])

The max\_range parameter is the interval within which the maximum value is determined. The Excel software searches for the maximum value exclusively among the cells of the specified range (max\_range) that align with the cells satisfying the given criteria. The range1 parameter represents the initial range of cells to be considered when evaluating the maximum criteria. On the other hand, the criteria1 parameter denotes the primary criterion, which is specified as a textual value and is used to determine the inclusion of cells in the evaluation process. The criterion is applied by Excel

to range. The maximum number of range/criterion pairs that can be entered is 127.

The MINIFS function is utilized to retrieve the minimum value from a specified range, based on the cells within one or more ranges that satisfy one or more requirements.

MINIFS(min\_range, range1, criteria1[, range2, criteria2, ...])

The min\_range parameter is the interval within which the minimal value is determined. The Excel software application selectively identifies the least value inside the specified range, limited to the cells that satisfy the given criteria. The range1 parameter represents the first range of cells that will be utilized for establishing the minimal criteria. On the other hand, the criteria1 parameter denotes the first criterion, which is inputted as text, and serves as the basis for determining the cells that will be included. The criterion is applied to range1 by Excel. Users have the ability to input a maximum of 127 pairs consisting of a range and a corresponding criterion.

### **Apply multiple exact-match criteria to a value**

The previously mentioned IFS function discussed in this aim provides the capability to generate complex criteria by utilizing comparison operators such as less than (<) and larger than or equal to ( $\geq$ ). However, it is frequently observed that comparisons often necessitate the use of the equal operator (=) for accurate matching. In instances of this nature, use the SWITCH function is frequently more convenient in comparison to IFS.

The SWITCH function in Excel is designed to assess an expression, compare the resulting value with a provided list of values, and afterwards provide a value that corresponds to the first match identified by Excel.

SWITCH(expression, value\_to\_match1, value\_to\_return1[, value\_to\_match2, value\_to\_return2, ..., value\_if\_no\_match])

SWITCH evaluates expression first. SWITCH then compares this result to each value\_to\_match argument; if a match is found, it

returns the corresponding value\_to\_return argument; otherwise, it returns the value\_if\_no\_match argument. You are permitted to input up to 126 match/return value pairs.

For instance, the MONTH function returns a number between 1 (for January) and 12 (for December) when given a date. For a date in cell A2, the following SWITCH formula can be used to return the month name based on the value of the MONTH(A2) expression:

```
=SWITCH(MONTH(A2), 1, "January", 2, "February", 3, "March", 4, "April", 5, "May", 6, "June", 7, "July", 8, "August", 9, "September", 10, "October", 11, "November", 12, "December", "No matching month!")
```

## **F. How to manage advance charts and tables**

External databases and worksheets may contain hundreds of thousands or even millions of records. Without the proper instruments, analyzing this volume of data can be incredibly challenging. Excel provides three effective data analysis tools: charts, pivot tables, and pivot charts. Using these tools, you can summarize or visualize voluminous datasets in a concise format.

If two or more data series are displayed in a single chart, you can change the chart type for one or more series to produce a combination chart. By utilizing a variety of chart types, you can make it simpler for your audience to differentiate between data categories displayed in the same chart.

To convert a chosen chart to a dual-axis chart:

- a. Select the illustration by clicking on it.
- b. Click Change Chart Type in the Type group of the Chart Design tab to access the Change Chart Type dialogue box.
- c. In the category list on the All Charts tab, select Combo.
- d. Select the desired chart type for each series in the Chart Type list.
- e. Select the Secondary Axis checkbox for a particular series.
- f. To close the Change Chart Type dialogue box and return to the worksheet, click OK.

Series Name	Chart Type	Secondary Axis
Homes Sold	Clustered Column	<input type="checkbox"/>
Average Price	Line	<input checked="" type="checkbox"/>

To visually analyze data, the majority of Excel users rely on one of its standard chart types, such as Column, Line, Pie, Bar, Area, X Y (Scatter), or Stock. These are useful chart types that accomplish most tasks, but for more technical or complex situations, you may need to consider one of Excel's advanced chart types:

- a. Box and Whisker
- b. Combo (see preceding section)
- c. Funnel
- d. Histogram
- e. Map
- f. Sunburst
- g. Tree map
- h. Waterfall

### Reference

Joan Lambert & Curtis Frye. 2022. Microsoft Excel Step by Step (Office 2021 and Microsoft 365). London: Pearson Education, Inc.



## UNIT IX

### MANAGER REFERENCES: ZOTERO

**Learning Objectives:**

After taking this chapter, you'll be able to:

1. What is Zotero?
2. What is the different of Zotero and other manager references?
3. How to use Zotero?

#### A. Introduction

Zotero, a reference management software, has been in existence since 2006, and continuous efforts have been made to enhance its functionality and features on a daily basis. New features are consistently incorporated into our system on a regular basis. In the event that a bug is encountered, we strive to promptly provide a resolution within a timeframe of one to two days. We prioritize the provision of support for newly released operating systems, browsers, and word processors. The user's text is already academic. The developers of Zotero engage in an open collaborative process, allowing interested individuals to track ongoing developments on GitHub. By actively participating in conversations within the Zotero Forums, users can directly contribute to shaping the future trajectory of the software.

Zotero, being an open-source application, possesses a dual sense of freedom. Firstly, it is devoid of any monetary cost, allowing users to utilize it without financial obligations. Secondly, it grants users the liberty to modify its underlying code, so enabling

customization to align with individual preferences and requirements. The advantages of the initial option are readily apparent; however, the significance of the second option is paramount when considering a program that will be entrusted with one's study data. Zotero has consistently ensured customers with unrestricted access to their personal data. However, the open-source nature of the platform obviates the necessity to just rely on our assertions. In the event of the hypothetical dissolution of the governing body overseeing Zotero or the implementation of a decision that fails to prioritize user interests, the source code of Zotero would remain accessible for interested parties to assume responsibility for its maintenance and enhancement.

## **B. What is Zotero**

Zotero is created by a non-profit organization that operates independently and lacks any financial stake in the user's data. The organization prioritizes privacy considerations in all decision-making processes. Zotero is a software application that operates locally, storing user data on the individual's personal computer. It offers the convenience of independent usage without necessitating the exchange of any data with the developers. Notably, the creation of a Zotero account is not a must for utilizing the program. The user's text is too short to be rewritten academically. If users opt to share their data, for instance through the utilization of Zotero sync, they can find solace in the understanding that we simply employ it to enhance their user experience, without perceiving it as a potential source of cash.

The efficacy of policies would be inconsequential if Zotero did not possess the attributes of a robust and sophisticated instrument designed for professional use. Zotero possesses an unparalleled capability to store and preserve publication data of superior quality obtained from various sources such as websites, journal articles, newspapers, and other relevant materials. Additionally, it is equipped with the functionality to extract publication data for PDF files that are manually imported into the system. The incorporation

of word processor integration for popular platforms such as Word, LibreOffice, and Google Docs facilitates the seamless management of citations and bibliographies during the writing process. The presence of an integrated PDF reader facilitates the annotation of PDF files, enabling the extraction of referenced quotations and comments directly into notes or word processor documents. Zotero has the capability to automatically retrieve publishing data using either the DOI or ISBN, and it can even locate open-access PDFs in instances where the user does not possess access to the paper. Users have the ability to generate sophisticated search queries, such as retrieving all articles that reference a specific keyword within the past month, and store them as collections that automatically update. Zotero has the capability to automatically redirect users through their institution's proxy when they attempt to view a paywalled webpage, thereby enabling them to obtain access to the PDF content. Zotero has the capability to provide users with a warning in the event that they attempt to cite a paper that has been retracted.

In addition to its inherent capabilities, Zotero has a plugin system that enables external developers to enhance its operation by incorporating advanced features, like enhanced file management and increased support for BibTeX.

### **C. What is the Different of Zotero and Other Manager References**

Several other reference managers experience extended periods of limited development, which can negatively impact productivity and hinder researchers' access to their data. For instance, it took EndNote approximately seven months after the release of Word 2016 to provide support for this version. The support for the most recent versions of macOS by Mendeley has been a time-consuming process, spanning multiple years. Furthermore, the resolution of issues regarding the disappearance of PDFs from users' libraries took around two months.

Mendeley, RefWorks, EndNote Web, and Paperpile necessitate user authentication for access. Consequently, in the event that the software providers discontinue support or experience temporary service disruptions, users would encounter difficulties in accessing their respective libraries.

Mendeley employs encryption techniques to safeguard its database, so impeding the complete exportation of data to external tools and even restricting access to the data in the event of program unavailability. According to EndNote, it is asserted that the accessibility of EndNote files is limited exclusively to their proprietary software.

Mendeley, RefWorks, Papers, and Paperpile are commercial software applications that are proprietary and closed source in nature. However, it is worth noting that these applications rely on open-source software developed by the Zotero community. The citation processor that was created to increase the citation capabilities of Zotero is utilized by all users. The majority of the numerous citation styles available in Zotero were either requested or developed by users of the platform. The Mendeley word processor plugin is developed using an initial iteration of Zotero's plugin. RefWorks utilizes the site translators of Zotero in order to facilitate the preservation of bibliographic data from a web browser. By utilizing Zotero, users can benefit from enhanced support and timely updates, while also having the opportunity to contribute to the advancement of these software solutions.

Zotero uses the following databases for looking up item metadata: Library of Congress and WorldCat for ISBNs, CrossRef for DOIs, NCBI PubMed for PubMed IDs, and arXiv.org for arXiv IDs. Also Add Item by Identifier (ISBN, DOI, PubMed ID, or arXiv ID).

#### **D. How to Use Zotero**

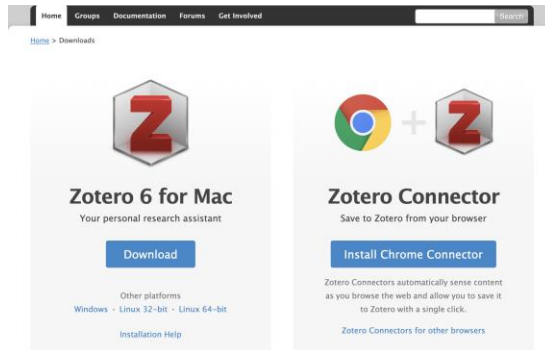
Zotero helps you organize your research any way you want. You can sort items into collections and tag them with keywords. Or create saved searches that automatically fill with relevant materials



as you work. Zotero instantly creates references and bibliographies for any text editor, and directly inside Word, LibreOffice, and Google Docs. With support for over 10,000 citation styles, you can format your work to match any style guide or publication.

1. Download the application

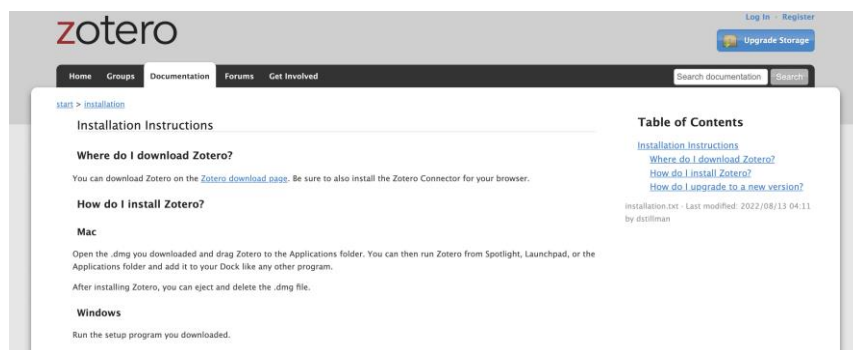
Please download and register as a user of Zotero using this link below: <https://www.zotero.org/>



2. After download, please install the Zotero application, and register as a user.



Or click this link to read the installation instructions:  
<https://www.zotero.org/support/installation>



3. Plugins for Zotero
  - a) An active community of Zotero users has developed a variety of plugins to provide enhancements, new features, and interfaces with other programs.
  - b) To install a plugin in Zotero, download its .xpi file to your computer. Then, in Zotero, click “Tools → Add-Ons”, then drag the .xpi for the plugin onto the Add-Ons window that opens.
  - c) Note: for apps and plugins for mobile devices, see mobile.

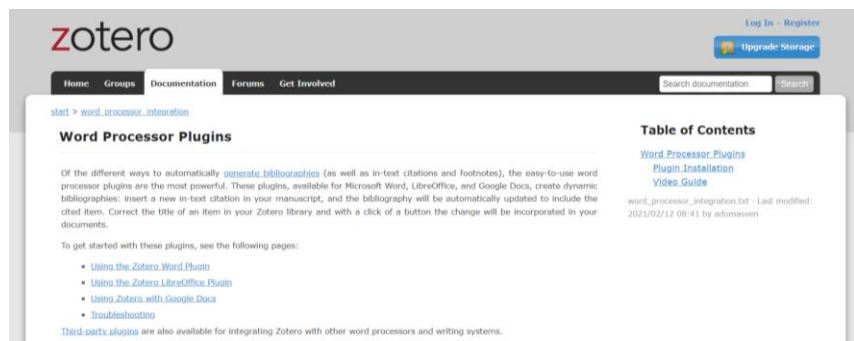
The Zotero connector:



#### 4. Instalasi Standalone

Use this link to install plugins:

[https://www.zotero.org/support/word\\_processor\\_plugin\\_usage](https://www.zotero.org/support/word_processor_plugin_usage)



This is the plugins of Zotero in to the Microsoft word:

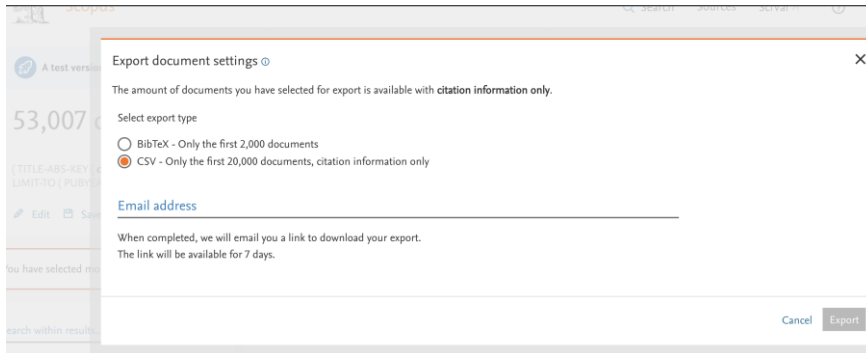


You can Add citation/edit citation and make bibliography using Zotero after you create your library into your Zotero application.

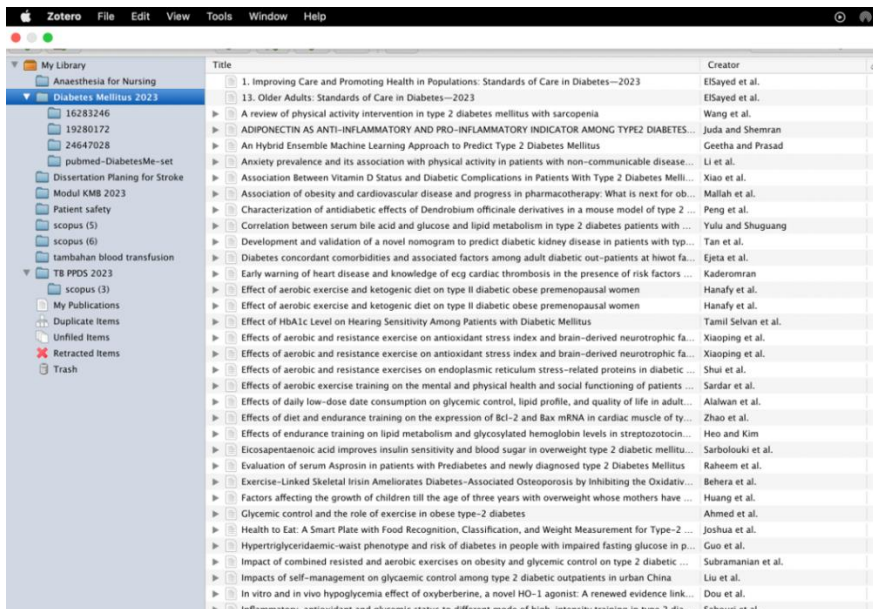
## 5. Export document settings

Export the article that will be insert to the Zotero (from science direct, scopus.com, sage pub, PubMed, Ebsco, etc.

For example:



## 6. Zotero's feature



## 7. Let's make practice

## Reference

Zotero. 2023. <https://www.zotero.org/>



## UNIT X

# QUILLBOT: AN ARTIFICIAL INTELLIGENCE PARAPHRASING TOOL ONLINE

### **Learning Objectives:**

After taking this chapter, you'll be able to:

1. Definition of QuillBot
2. How to use QuillBot

### **A. Introduction**

Welcome to the current epoch characterized by the prevalence of artificial intelligence (AI), which significantly facilitates various tasks, particularly in the domain of writing. In this discourse, we shall examine QuillBot, an artificial intelligence (AI) platform that has gained widespread use as a valuable tool for enhancing writing quality and ensuring originality by mitigating the risk of copying.

### **B. Definition of QuillBot**

QuillBot, accessible at [www.quillbot.com](http://www.quillbot.com), is an artificial intelligence (AI) platform primarily designed to serve as a grammar checking tool, as well as a paraphrase tool to prevent instances of plagiarism. QuillBot is accessible in multiple linguistic variations, encompassing the Indonesian language. The utilization of QuillBot enhances the clarity, efficacy, and accuracy of your writing.

QuillBot's features include:

1. QuillBot Grammar Check
2. QuillBot Citation

3. QuillBot Indonesian
4. QuillBot APK
5. QuillBot Premium
6. Indonesian Version of QuillBot
7. QuillBot Download

The features of QuillBot include a variety of functionalities that enhance its utility and effectiveness. QuillBot provides a range of intriguing features:

1. Grammar Check: Please review the grammar of the text and provide ideas for improvement, if necessary.
2. The citation tool facilitates the creation of accurately prepared citations.
3. A version in the Indonesian language is provided to facilitate usage for those in Indonesia.
4. The QuillBot APK is accessible for download as an Android application.
5. QuillBot Premium encompasses further functionalities that are acquired upon subscribing to the premium version.
6. The Indonesian version of the display is designed to provide a user-friendly experience for Indonesian users.
7. The QuillBot software can be obtained in downloadable formats that are compatible with several platforms.

QuillBot provides a no-cost option for use, while also presenting a premium service that encompasses other functionalities capable of enhancing one's efficiency.

### **C. How to Use QuillBot**

In order to utilize QuillBot, it is necessary to adhere to the following instructions:

1. To gain entry to the website [www.quillbot.com](http://www.quillbot.com) or acquire the corresponding application, please proceed accordingly.
2. To access the features of QuillBot, users are required to either create a new account or log in using their existing credentials.

3. Please choose the desired functionality you wish to utilize, such as QuillBot Grammar or QuillBot Indonesia.
4. Please input the text you wish to verify or modify, and then select "Quill It!"
5. Please allow a little pause, after which the screen will display the outcomes of the repair or paraphrasing process.
6. The outcome can be tailored by modifying the paraphrase mode or implementing manual adjustments.

Undoubtedly, every tool possesses both merits and demerits, and QuillBot is no exception. This article presents a comprehensive analysis of the advantages and cons associated with the utilization of QuillBot.

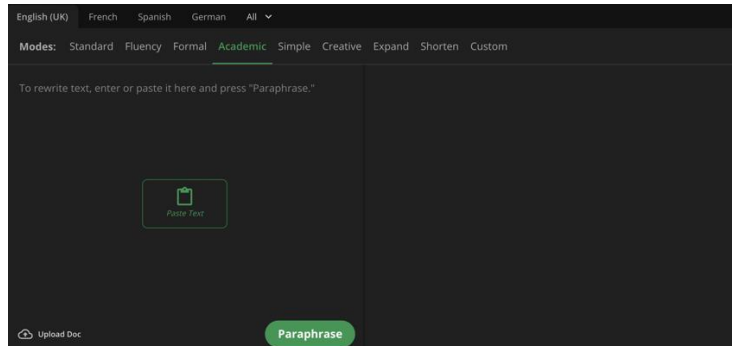
1. The software is designed to be user-friendly, featuring an interface that is easy to navigate.
2. The availability of the Indonesian language option facilitates user accessibility for individuals residing in Indonesia.
3. The software can be utilized for no cost, albeit with restricted functionalities.
4. Paraphrasing encompasses various techniques that aid in the prevention of plagiarism and enhance the efficacy of language modification.
5. An Android application (APK) exists that facilitates user-friendly utilization on mobile devices.
6. This application presents a selection of extensions that are compatible with both the Chrome browser and Microsoft Word, offering users the ability to enhance their browsing and word processing experiences.

Insufficiency:

1. The complimentary version imposes a constraint on the quantity of words that can undergo processing.
2. It may be necessary to verify the accuracy and fluency of the language in order to assure the quality of the paraphrased results.



To use the paraphraser, start by either typing or pasting the text you want to change into the section on the left:



Modes refer to a configuration that alters the specific aspects that the QuillBot AI will prioritize during the process of paraphrasing. Each form of analysis directs its attention towards various aspects within your text.

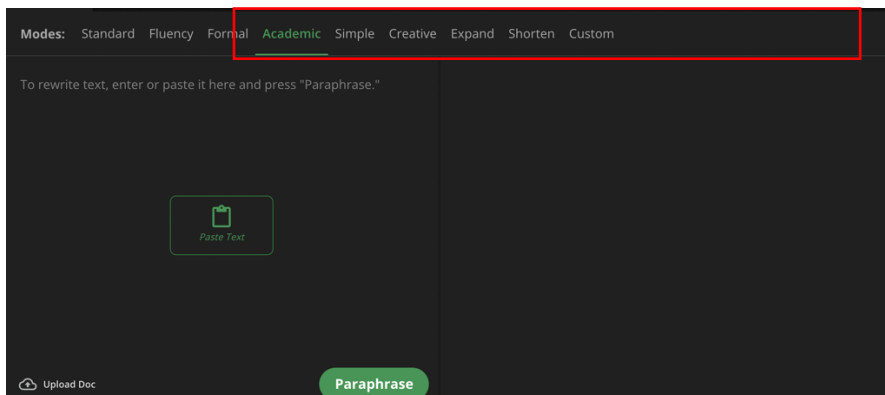
There exists a total of seven modes, which can be enumerated as follows:

1. **Standard:** The term “standard” refers to a widely accepted or established level of quality, performance, the default setting for this mode is the one currently being referred to. The act of modifying the text while preserving its core meaning is employed to achieve a harmonious equilibrium between alteration and authenticity, resulting in a more organic rendition.
2. **Fluency:** The concept of fluency refers to the ability to communicate in a language with ease, accuracy This option guarantees the absence of grammatical errors and verifies the authenticity of the material. The Fluency mode minimizes the number of modifications made while preserving the original meaning intact. Synonyms are set to the minimum level.
3. **Formal:** Please rewrite the user’s text to be more formal and academic in tone. Avoid adding any This function alters the text to appear and sound more formal and scholarly. This

particular choice presents a highly advantageous alternative for composing works inside academic or professional settings.

4. **Simple:** In a straightforward manner. The objective of this setting is to enhance the readability and accessibility of your writing.
5. **Creative:** The user's text can be rewritten as follows: "The user's input exhibits a creative This mode entails making extensive modifications to the text in order to achieve a distinct appearance and tone. There is a potential for the alteration of meaning when employing this approach.
6. **Shorten:** Please make the user's text more academic without adding any information. This mode aims to condense the text to its essential elements without altering its intended message. This approach is effective in decreasing the overall word count.
7. **Expand:** Please provide more details or elaborate on your statement. The purpose of this mode is to augment the length of the text to the greatest extent feasible by incorporating additional words. This strategy is beneficial in situations where there is a requirement to augment the total number of words.

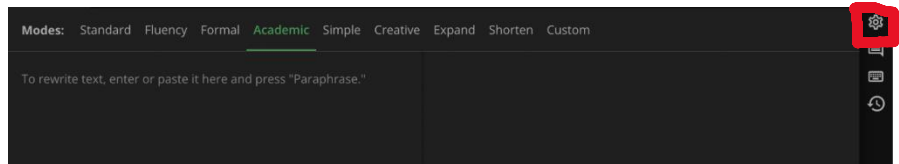
The selection of a mode can be altered by means of a click on the desired mode's name. The locations of the modes are indicated by red circles in the provided illustration.



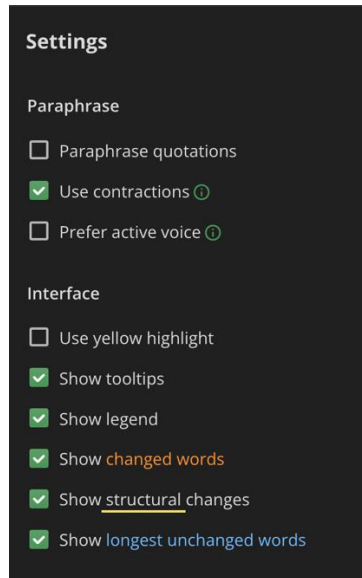
When a paraphrased statement from an external source is properly cited, it does not constitute plagiarism. Paraphrasing tools are considered acceptable for including a user's own writing; nonetheless, it is crucial to acknowledge and cite any paraphrased quotes or language derived from external sources.

The primary purpose of QuillBot is not to facilitate plagiarism, and we strongly discourage the utilization of our product for such purposes. It is imperative to consistently acknowledge and reference the sources utilized in one's work, while adhering to the established guidelines and protocols advocated by one's academic institution or employer. It is imperative to refrain from engaging in plagiarism by utilizing QuillBot.

The options pertaining to the modes and the Word Flipper feature can be accessed by clicking the gear icon located on the right side of the screen. The item in question has been highlighted with a red circle in the accompanying image.



Upon selecting the gear icon, a menu will be displayed on the right-hand side, presenting a range of configurable settings.



There exist two distinct groups of environments. The initial component, referred to as “Paraphrase,” encompasses a range of configurations that alter the functionality of the AI system in the context of paraphrasing. The aforementioned settings are as follows:

1. **Paraphrase quotations:** When the checkbox is selected, the artificial intelligence (AI) system will rephrase sentences that are included within quotation marks.
2. **Use contractions:** If this box is selected, the artificial intelligence (AI) will employ contractions, such as “do not,” “cannot,” “should not,” and so on. By deselecting the checkbox, the functionality associated with these specific phrases will be deactivated, resulting in their replacement with alternative expressions such as “do not,” “cannot,” “should not,” and so on.
3. **English dictionary:** The English dictionary is a comprehensive reference tool that contains a vast collection of words and their definitions. It serves as a valuable resource for Upon selecting this option, a drop-down menu will be

displayed, presenting a selection of English language dictionaries available for use. At present, our language offerings encompass American English, UK English, and Australian English variants.

The second set of configurations, referred to as “Interface,” pertains to the visual aspects displayed within the paraphraser. The aforementioned settings are as follows:

1. **Use yellow highlight:** The modification alters the color of the highlighted section in the paraphraser tool, shifting it from the original blue hue to a yellow shade.
2. **Show tooltips:** Enabling this option will disable the display of tooltips.
3. **Show Legend:** The color legend can be hidden by unchecking the corresponding box.
4. **Show changed words:** Deselecting this checkbox will prevent modified terms from being highlighted in orange inside your outcomes.
5. **Show structural changes:** Disabling the selection of this checkbox will prevent the highlighting of structural modifications in yellow within the displayed outcomes.
6. **Show longest unchanged words:** This analysis aims to present the longest words that have remained unaltered across time. Disabling the selection of this checkbox will prevent the section of your results that has remained constant for the longest duration from being visually highlighted in the color blue.

## Reference

Quillbot. 2023. Basic Reading and Writing. <https://quillbot.com/courses/introduction-to-college-reading-and-writing-b/part/module-1/>



## UNIT XI

# TURNITIN: PLAGIARISM CHECKER

### **Learning Objectives:**

After taking this chapter, you'll be able to:

1. What is the definition of Turnitin
2. How to use Turnitin

### **A. Introduction**

Turnitin is widely regarded as a highly effective tool that is commonly employed by numerous colleges throughout different locations in Indonesia, encompassing both State colleges and Private Higher Education Institutions.

It should no longer come as a surprise that Turnitin is considered a mandatory checkpoint for writers and researchers of academic papers, including students and instructors. Indeed, it frequently presents itself as a test or challenge for students to successfully complete their studies and for educators to fulfil the criteria for credit score evaluation or the publication of scholarly articles in esteemed international publications such as SINTA and SCOPUS.

The Turnitin application is particularly beneficial for educational institutions seeking to guarantee the originality and non-publication of every written paper. In order to mitigate the occurrence of plagiarism and foster a culture of respect for intellectual property, it is imperative for institutions to adopt measures that discourage such unethical practices.

## **B. What is the Definition of Turnitin**

Turnitin is an online platform that offers a service for finding textual similarities in various forms of written content, such as academic papers, scientific journals, and articles. It accomplishes this by comparing the submitted texts to a vast database of published works.

The text under consideration encompasses many articles found on websites, publications, and other textual sources. The level of similarity will be denoted by a similarity percentage (score) derived from the quantity of shared words, phrases, and paragraphs between each identified article or paper.

In order to utilize the services offered by Turnitin, it is necessary for users to complete a registration process, which is contingent upon their designated access permissions as either a Student, Instructor, or Administrator. The access right in question pertains to the individual who is the first registrant for utilizing the Turnitin program, regardless of their role as a lecturer, student, teacher, etc. Is it permissible for an author to utilize the Turnitin service? Certainly, one can simply modify it in accordance with the requirements for utilizing Turnitin.

Before registering at Turnitin, it is essential to have a comprehensive understanding of the various access rights that are associated with the platform. These access rights encompass a range of permissions and privileges that users must be aware of in order to effectively navigate and utilize the features and functionalities of Turnitin.

1. Student/Students: Access rights, referred to as students or student users, are utilized by individuals to enroll in classes that have been established by instructors. In this scenario, students are individuals who are enrolled as participants in the class.
2. Instructor, may I inquire about the access privileges utilized by the user (Tutor/Staff/Lecturer) for the purpose of establishing a class with the objective of overseeing the supplied written outcomes of one or multiple students?

In order to utilize the services offered by Turnitin, users are required to pay a price to access all the features supplied by this esteemed website. Additionally, affiliated institutions may offer a free account, albeit with limited functionality, to their students. It should be noted that certain elements on the Turnitin website may not be available to student users.

Due to the intricate structure and algorithm incorporated within Turnitin, consumers are unable to access all of its services without charge. Consequently, users are obligated to remunerate for the utilization of Turnitin's services through either periodic payments on a monthly or annual basis. This financial commitment is necessary to have access to and employ the platform.

The concept of excess refers to the state of having an abundance or surplus of something beyond what:

1. One capability of the software is its ability to effectively mitigate instances of plagiarism by accurately identifying and distinguishing original content from potentially plagiarized material. Upon utilizing the Turnitin service, individuals are able to ascertain the authenticity of their written content.
2. It is possible to verify the examiner's comments by reviewing the recorded or typed feedback.
3. The objective is to offer consumers with comprehensive and precise feedback service, while alleviating concerns regarding the anonymity of the system's outcomes.
4. The inspection findings demonstrate a high level of efficiency when compared to other tools. This is due to the tool's ability to check an unlimited amount of pages and words within a short span of time, provided that there is a reliable internet connection.

The absence or insufficiency of something:

1. In order to utilize the service site provided by Turnitin, it is important to have a reliable and uninterrupted internet connection.
2. Turnitin lacks the ability to effectively differentiate texts that have undergone special treatment and accurately cite them.



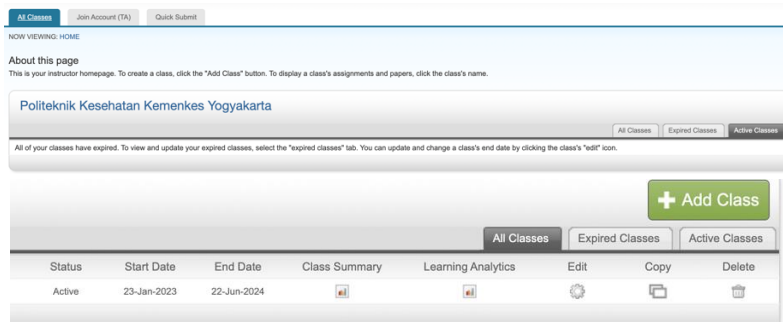
3. The website frequently experiences downtime and sluggishness, necessitating the need to reload the webpage.

### C. How to Use Turnitin

Turnitin has the capability to handle several file formats, including Microsoft Word (DOC, DOCX), Corel WordPerfect, HTML, Adobe PostScript, Plain text (TXT), Rich Text Format (RTF), Portable Document Format (PDF), OpenOffice (ODT), Hangul (HWP), and PowerPoint (PPT).

Practice to use Turnitin:

1. Access to the internet is necessary.
2. Please access the website [www.turnitin.com](http://www.turnitin.com).
3. Please select the “Login” option.
4. Please provide your username (email) and password for your Turnitin account.
5. Files can only be uploaded to a certain “Class” and “Assignment”.
6. For each conference activity, lecturer’s draft articles, lectures, a new “Class” should be defined.
7. Click Add Class



## 8. Create a new class

The screenshot shows a web form titled "Create a new class" with the following fields and options:

- Class type:** A dropdown menu set to "Standard".
- Class name:** An empty text input field.
- Enrollment key:** An empty text input field.
- Subject area(s):** A dropdown menu set to "Select subject(s)".
- Student level(s):** A dropdown menu set to "Select student level(s)".
- Class start date:** A date field set to "20-Feb-2018".
- Class end date:** A date field set to "25-Aug-2018" with a calendar icon.

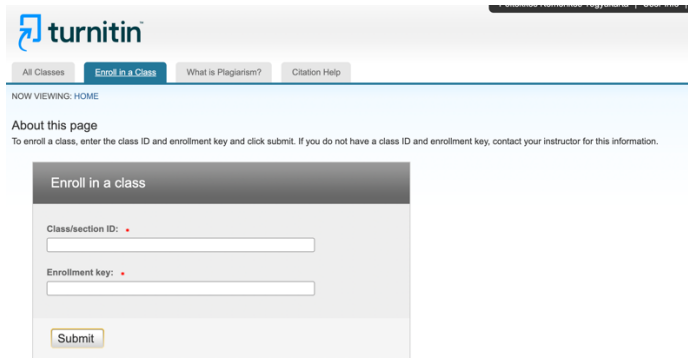
At the bottom of the form are two buttons: "Cancel" and "Submit".

It is important to direct one’s focus towards the formation of the “Class ID.” This inquiry pertains to the safeguarding of “Class ID” and “Enrollment key” information to prevent unauthorized access. By providing the necessary “Class ID” and “Enrollment key” details, individuals can successfully complete the registration process as a student. Please proceed by selecting the “Continue” option.

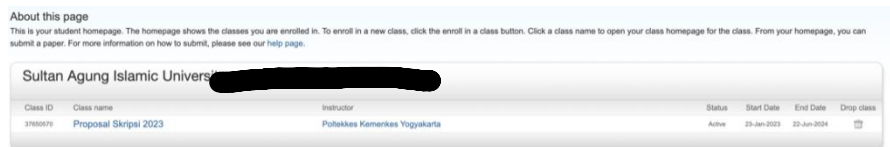
9. For Student Account, Input Class ID and Enrollment key that shared from your instructor.

The screenshot shows the Turnitin student homepage with the following elements:

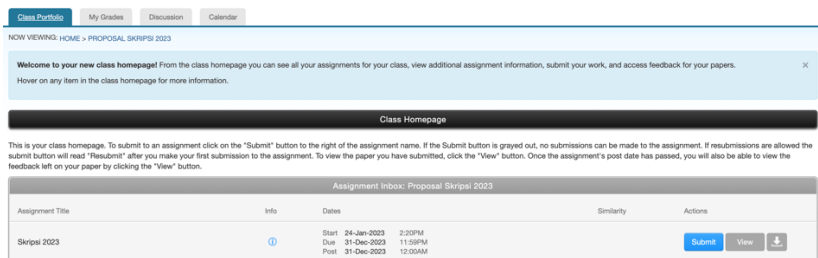
- Turnitin logo:** Located at the top left.
- Navigation menu:** Includes "All Classes", "Enroll in a Class", "What is Plagiarism?", and "Contact Help".
- Header:** "NOW VIEWING: HOME".
- About this page:** A section explaining the homepage's purpose and providing a link to the help page.
- Welcome!:** A section with a message: "Welcome! If you are ready to enroll in a class, make sure you have already received the class ID and enrollment password from your instructor. Click here to enroll in a class." Below this message is a yellow button with a green plus icon and the text "enroll in a class".



10. This is the account for student after input Class ID and enrollment key



11. Click the "Class name" and Klick "Submit".



12. Fill your first name, last name, and submission title, and choose the paper/file that would be check it (from your computer/dropbox/google drive), then click upload

Submit: [Single File Upload](#) STEP ● ○ ○

First name  
Poltekkes Kemenkes

Last name  
Yogyakarta

Submission title

[What can I submit?](#)

Choose the file you want to upload to Turnitin:

We take your privacy very seriously. We do not share your details for marketing purposes with any external companies. Your information may only be shared with our third party partners so that we may offer our service.

13. Click “Confirm”

Please confirm that this is the file you would like to submit...

Author:  
Poltekkes Kemenkes Yogyakarta

Assignment title:  
Skripsi 2023

Submission title:  
xxxx

File name:  
Revised Chapter 9 Medical Surgical Modul 1 Term  
2023.docx


File size:  
11.05M

Page count:  
54

Word count:  
13361

Character count:  
81844

« Page 1 »



We take your privacy very seriously. We do not share your details for marketing purposes with any external companies. Your information may only be shared with our third party partners so that we may offer our service.

## 14. Click return to assignment list

**Author:**  
Poltekkes Kemenkes Yogyakarta

**Assignment title:**  
Skripsi 2023

**Submission title:**  
XXXX

**File name:**  
Revised Chapter 9 Medical Surgical Modul 1 Term 2023.docx

**File size:**  
11.05M

**Page count:**  
54

**Word count:**  
13361

**Character count:**  
81844

**Submission date:**  
28-Aug-2023 05:29AM (UTC+0700)

**Submission ID:**  
2152251289



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## 15. Click similarity

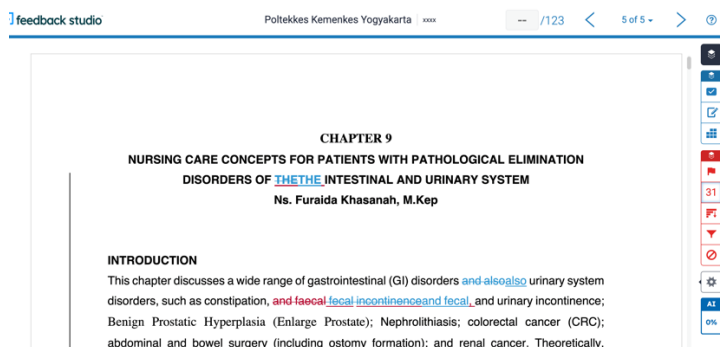
Class Homepage

This is your class homepage. To submit to an assignment click on the "Submit" button to the right of the assignment name. If the Submit button is grayed out, no submissions can be made to the assignment. If resubmissions are allowed the submit button will read "Resubmit" after you make your first submission to the assignment. To view the paper you have submitted, click the "View" button. Once the assignment's post date has passed, you will also be able to view the feedback left on your paper by clicking the "View" button.

Assignment Inbox: Proposal Skripsi 2023

Assignment Title	Info	Dates	Similarity	Actions
Skripsi 2023		Start 24-Jan-2023 2:20PM Due 31-Dec-2023 11:59PM Post 31-Dec-2023 12:05AM		<a href="#">Submit</a> <a href="#">View</a>

- Waiting the feedback from instructor to know the result of your paper



The outcomes obtained by conducting a “Similarity Index” assessment with the use of Turnitin are as follows:

- The color blue (Similarity Index 0%) is being discussed.
- The color green has a similarity index ranging from 1% to 24%.
- The color yellow exhibits a similarity index ranging from 25% to 49%.
- The color orange (with a similarity index ranging from 50% to 74%)
- The color red has a similarity index ranging from 75% to 100%.

#### Skripsi 2023

INBOX | NOW VIEWING: NEW PAPERS ▼

Submit File		Online Grading Report   Edit assignment settings   Email non-submitters						
<input type="checkbox"/>	AUTHOR	TITLE	SIMILARITY	GRADE	RESPONSE	FILE	PAPER ID	DATE
<input type="checkbox"/>	Sarah Sarah 2	CLINICAL PERFORMANCE	13%	✓	+	📄	2129458801	09-Jul-2023
<input type="checkbox"/>	Sarah Sarah	A MULTICENTER RANDOMIZED	15%	✓	+	📄	2127659604	07-Jul-2023
<input type="checkbox"/>	Armi Armi	Naskah publikasi armi	24%	✓	+	📄	21486002618	15-Aug-2023
<input type="checkbox"/>	Poltekkes Kemenkes Yogyakarta	xxxx	31%	✓	+	📄	2152251269	28-Aug-2023
<input type="checkbox"/>	Doni Sellawan	Proposal Skripsi	68%	✓	+	📄	1998335236	24-Jan-2023

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### **Reference**

Turnitin. 2023. Student quick start guide. <https://help.turnitin.com/feedback-studio/turnitin-website/student/quickstart.htm>



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The author has contributed to organizational activities, research, training, publications, and as a speaker at 92 scientific meetings from 2007 to 2023. Organizational experience includes National Executive of the Indonesian Community Health Nurses Association (IPKKI) (2013 to 2018), Chair of IPKKI Yogyakarta (2019 to present), Secretary of the Community Nursing Collegium of the Indonesian National Nurses Association (INNA/PPNI) (2015 to 2020), Administrator of the PPNI Yogyakarta (2016 until now), Administrator of PPNI Sleman Regency (2017 until now), and National Board of the Association of Indonesian Nursing Vocational Education Institutions (2019-2023).

The latest research conducted by the author is entitled "Application of the Amphibian Family Resilience Model in Preventing Health Problems for Street Adolescents in Jabodetabek and Yogyakarta City" which was carried out in 2022. The latest book published in 2022 is entitled Pocket Book Tips for Increasing Family Resilience AMP/BI (I Want to be Sure Yes), and the latest journal publication is entitled "The Determinants of Active Aging for Improving Elderly Abilities" which was published in the Asian Journal of Pharmaceutical Research and Development in 2022. The author has received the Satyalancana Karya Satya 10-Year Award and the Satyalancana Karya Satya 20-Year Award from the President of the Republic of Indonesia.



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