Module I :
Computer and Nursing

Lesson 1:

What is Nursing Informatics?
a title that evolved from French word "**Informatique**"

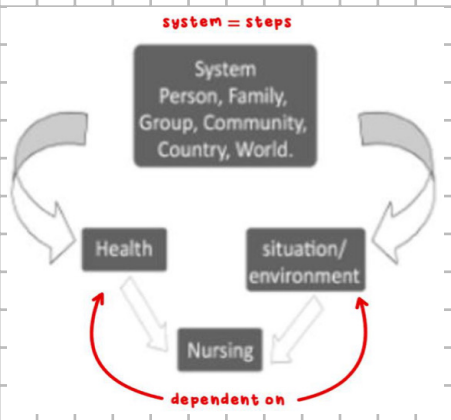
A specialty that integrates the following: **Nursing Science, Computer Science and Information Science.**

- **Nursing Science** – development of theories and practical concepts for improving how clinicians and patients administer care and manage conditions.
- **Computer Science** – study of computers and computational systems
- **Information Science** – science and practice of dealing with effective collection, storage, retrieval, and the use of information; administrative.

Refers to the field of applied computer science, concerned with the processing of information such as **nursing information.**

Systems Theory
- is largely accredited to the Austrian biologist, ***Karl Ludwig von Bertalanffy.***
- A group of elements that combine to produce one end result.
- The whole is greater than the sum of its parts.
- The theory looks at interacting parts within boundaries, and can be seen with the use of technology and the body systems of patients.

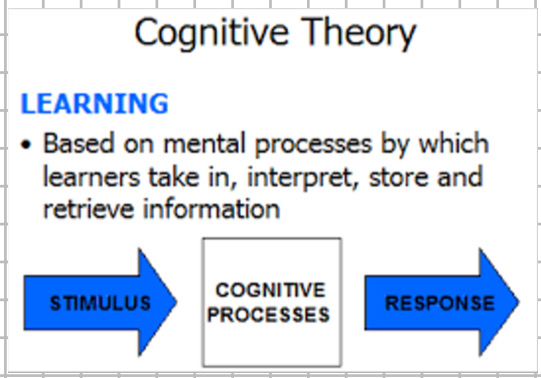
The underlying principle of the Systems Theory should seem largely intuitive to healthcare professionals.



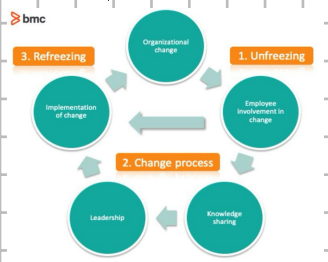
Cognitive Theory
The use of our mind or brain in learning, understanding, or receiving information.

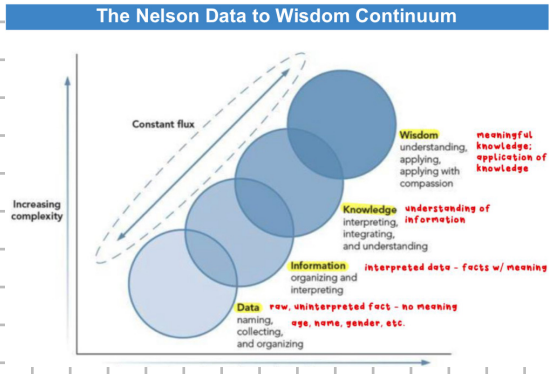
Our reaction to certain situation is dependent to our interpretation

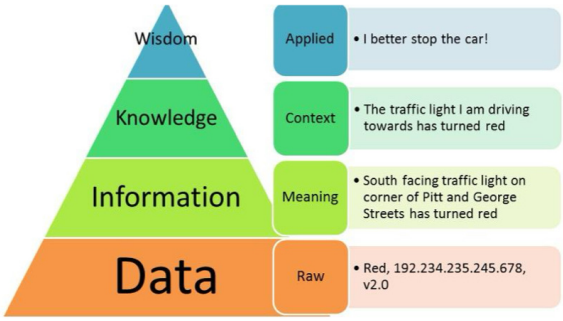
- One of the basic building blocks to help understand informatics.
- Related to the following; **input, output and processing information.**
- It helps understand the information processed by our brains.
- It includes the following:
  - Problem Solving
  - Decision Making
  - User Centered Interface



Change Theory (Moving Theory)
- **Kurt Lewin** (1890 – 1947), a Gestalt social psychologist, has been acknowledged as the "***Father of Change Theories***".**
- Applied in looking at the **dynamic processes** that are incorporated with nursing informatics.
- Involves an **action of planning and fact gathering** before proceeding on to the next phase of action,
- Lewin's Change Theory is a "**planned change**" guide that consists of three distinct and vital stages:
  - **Unfreezing Stage**: Seeing the problem needing changes; old pattern. E.g. paper-based.
  - **Moving to a New Level or Change Stage:** Doing something to change. E.g. train employees on how to use the computer.
  - **Refreezing Stage****: Problem solved; steady.







3 States of Data

1. **Data at rest:** Stored data.
2. **Data in use:** Rendering, processing, reading or writing)
3. **Data in motion:** **Moving between applications, over the network or internet (e.g. sending pictures)

Database

- Organized collection of related data; the possibility of finding databases depends on the following factors:
  - **Data naming (Indexing)** and **Organizational Schemes**
  - **Size** and **complexity** of the database
  - **Type of data** within the database
  - Database search methodology

Types of Data

2 primary approaches to classify data in a database system

1. **conceptual data type (qualitative)**
   - how the users will use the data financial, patient or human resource data
   - Has a major impact on how the designer indexes the data
   - Uses words

2. **computer-based data type** (quantitative)**
   - numbers, letters or combination
   - to build the physical database within the computer system
   - identifies the number of spaces and specific functions that the system can perform
   - numeric data perform numeric functions
   - logic data are limited

Database Management System (DBMS)

- computer programs that are used to *input, store, modify, process, and access data* in a **database***

Three interacting parts of a functioning DBMS:

- The Data
- The Designed Database
- The Query Language that is used to access data.

Examples of DBMS in everyday life:

- Computerized **library system**
- Automated **teller machines**
- **Flight reservation** system

Advantages of automated DBMS:

- **Decreased** data **redundancy/duplicated**
- Increased data **consistency**
- Improved **access to all data*** (as long as may internet)

Functions of DBMS:

- Store data
- Update records
- Provide easy retrieval of data
- Permit report generation

Data to Information

Common Database Operations

a. **Data Input Operations*** (encoding)
- input new data
- update data
- change or modify data

b. **Data Processing Processes**** (converts the data into a useful infromation)
- the purpose is to **extract information**
- discover new meanings
- reorder data

c. **Data Output Operations***** (final result)
- online and written reports
- processed data as charts and graphs

Data Warehouses

- a large collection of data imported from several different systems into ***one database****

Data marts are smaller collections of data.
Purposes:
- Spares users from the need to learn several different applications.
- Makes it possible to separate the analytical and operational processing.
- Provides an architectural design for the data warehouse that supports decisional information needs.
- The user can slice and dice the data from different angles and at different levels of detail.

Functions:
- Must be able to extract data from the various computer systems and import those data into the data warehouse.
- Must function as a database to store and process the data in the database.
- Must be able to deliver data in the warehouse back to the users in the form of information.

Data/Information to Knowledge

Knowledge Discovery and Data Mining (KDD)
- *find* previously **meaningless data**
– the process of **extracting information** and knowledge from large scale databases.

Data Mining

- to find previously unknown patterns and trends that will assist in providing quality care, predicting best treatment choices and utilizing health resources in a cost-effective manner

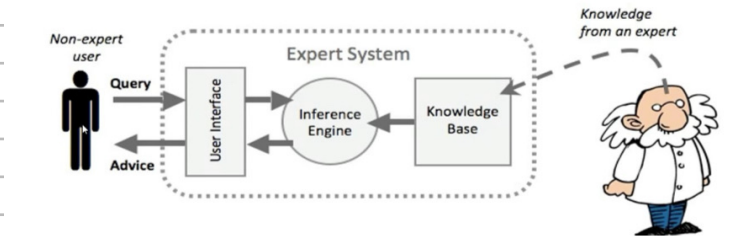
Seven Step Process:
- Task Analysis
- Data Collection
- Data Cleaning
- Data Mining
- Pattern Interpretation and Evaluation
- Deployment

Three Step Process by Bagga and Singh:
- Pre-processing
- Data Mining
- Post-processing

Wisdom

Knowledge Application
- Decision support systems produce knowledge from information.
- Experts systems use the knowledge from information and transform it to produce wisdom.
- A proposed theory of nursing knowledge or wisdom uses the formula: **NKW(IB) = P**
  - **NK**: Nursing Knowledge
  - **W**: Wisdom
  - **IB**: Individual Nurses Integration
  - **P**: Represents

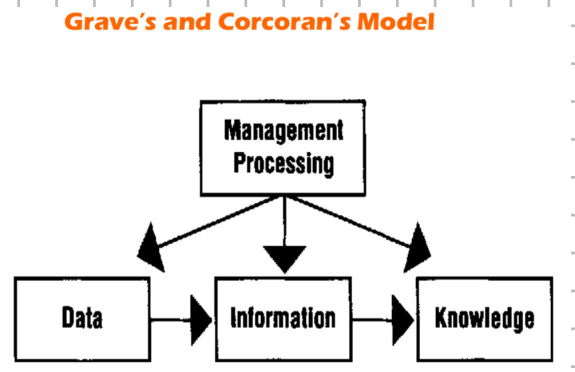
Expert Support/Systems
- *knowledge to wisdom*
- Represents the present and future vanguard of nursing informatics; aim to help to make the nurse more intelligent in providing quality care based on evidence.
- Usage of **Artificial Intelligence (AI)** to model the decision an expert nurse would make.*



Advantages of Expert Support/Systems:
- Provide a solution more quickly than humans
- Reduce waste and cut costs
- Improve patient care by sharing knowledge and wisdom of human experts

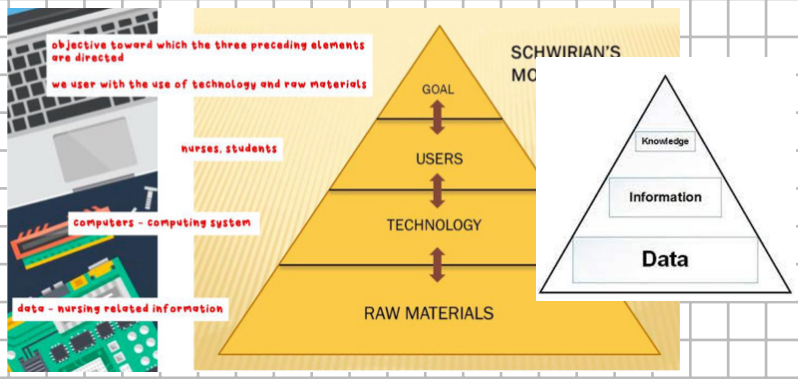
Four Main Components: *
- Natural Language - interact with the end user
- Knowledge Base
- Database
- Inference Engine - decision based system

Foundation of Knowledge Models
- study of illustrations



According to Grave and Corcoran:

- **Nursing Informatics as Linear and Sequential**
- Progression from Data Information to Knowledge.
- **Management Processing** is integrated in each element depicting *Nursing Informatics as the proper management of Knowledge, from data as it is converted to knowledge and information.*



Nursing Informatics is the use of information technology in relation to any of the functions which are within the purview of nursing which are carried out by nurses when performing their duties.

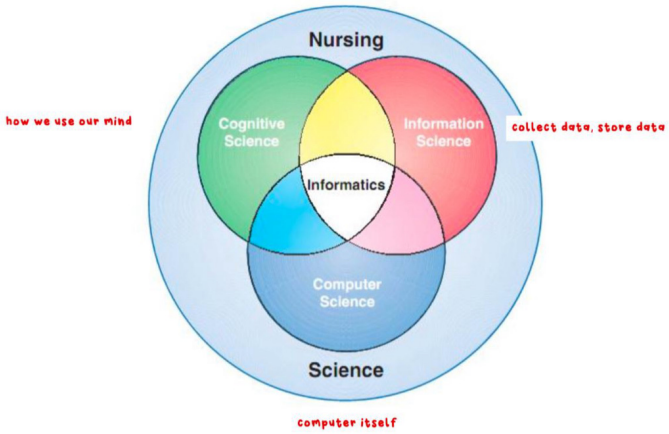
Nursing Informatics was depicted as an interface between the computer hardware and software, raw nursing information, and the user within the context of their profession or organization.

All of these elements lead to a common goal or objective.

Turley's Model (Venn diagram)

- Nursing Informatics is the interaction between the discipline specific science or Nursing Science and Areas of Informatics.

Core Components of Informatics:
Cognitive Science
Information Science
Computer Science

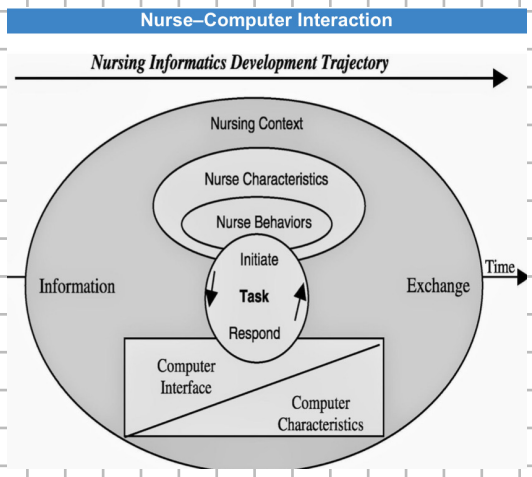


Werly and Grier's Model

- *Their model integrated *community data, institutional data, interpersonal data, and patient data* **into a hierarchical framework.**
- It was suggested that these information sets were needed to assist nurses in making decisions at various levels of functioning.**

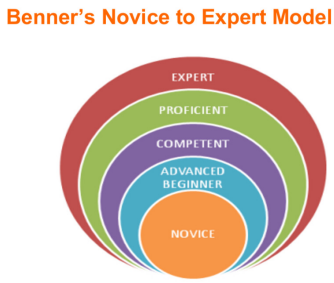
Werley - 1st nurse informatician

Staggers and Parks Nurse-Computer Interaction Framework



Time - trajectory object/factor in this model
"*Interaction/relations ship with the computer changes over time*"
Model made by Stagger and Park's; framework which has been used to help understand interactions between nurses, computers and enabling elements that optimize the ability of nurses to process information via computerized systems.

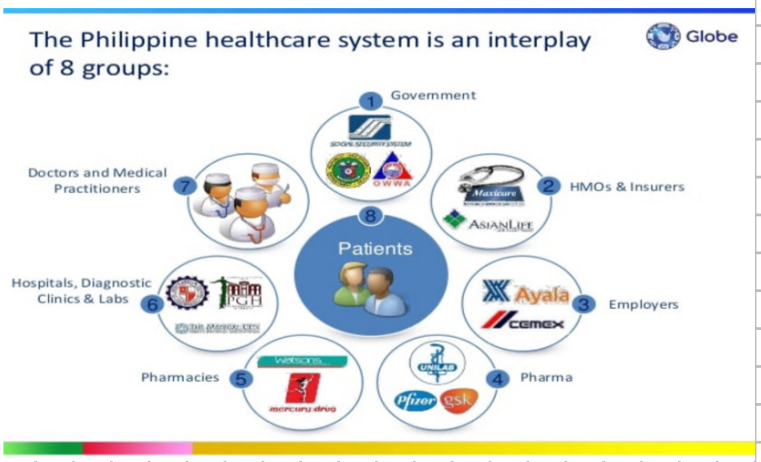
Benner's Novice to Expert Model



- Every nurse must be able to continuously exhibit the capability to acquire skills and then demonstrate specific skills beginning with the very first student experience.
- According to **Benner**, there are five levels of expertise:
  - Novice - no experience
  - Advanced Beginner
  - Competent
  - Proficient
  - Expert.

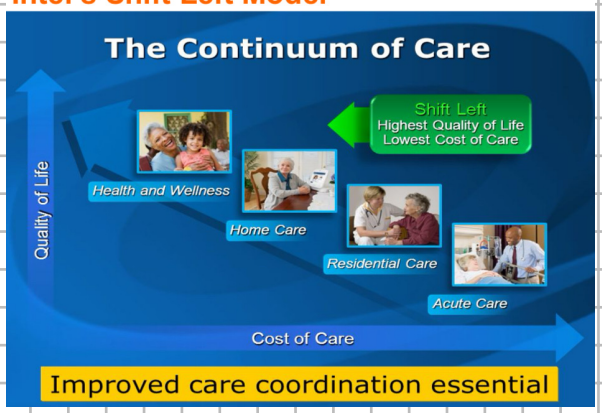
Novice	No experience (students, fresh graduates, etc…); expected to perform tasks with no confidence.	Beginner
Advanced Beginner	Demonstrate acceptable performance, but need supervision.	1 month experience
Competent	Enhanced mastery and can manage contingencies.	1 to 2 years experience; staff nurse
Proficient	Work with professional experience.	3 to 5 years; senior nurse
Expert	Master of concept.	//

Philippine Healthcare Ecosystem Model



- is an interplay of 8 groups
Government Doctors
HMO&Insurers. Patient - focus of the model
Pharma
Pharmacies
Hospitals

Intel's Shift Left Model



Purpose: to give high quality of care at the most lowest cost

Patient Medical Record Information Model: Basis of EHR

- The type and pattern of documentation in the patient record will be dependent on the three interacting dimensions of healthcare:
  - Personal Health Dimension
  - Health Care Provider Dimension
  - Population Health Dimension

Historical Perspectives of Nursing Informatics

Computers in Nursing

- Nursing Information Systems (NIS), nursing applications and/or Nursing Informatics (NI) affect all aspects of health care delivery.
- Manage monitor patient care quality, information and evaluate outcomes.
- Document and process real time plans of care, support nursing research and advance the role of nursing in the healthcare industry.

Prior to 1960s

- nursing profession was undergoing major changes
- **computers** were **used for basic office administrative** and **financial accounting functions only**
- used **punch cards** to store data and **card readers** to read computer programs
- computers were linked together and operated by **paper tape** and used **teletypewriters** to print output

1960's

- Uses of computers in the healthcare settings were being *explored**
- Nursing practice standards and resources were reviewed and analyzed. Computer technology was advanced and the **number of healthcare facilities increased**.**

1970's

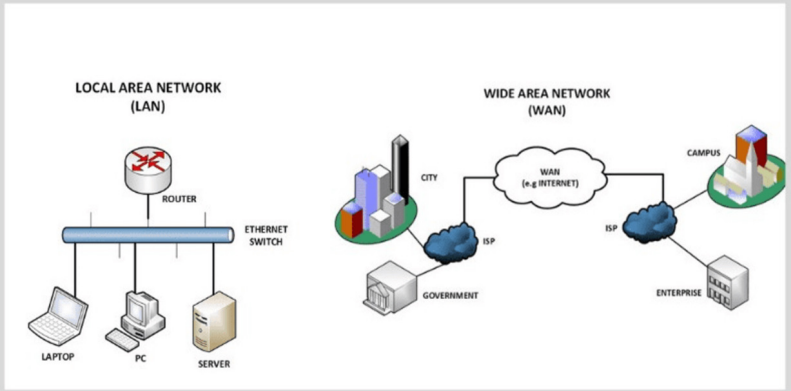
- Nurses began to value computers to their profession.
- Computers assisted in the design and development of **nursing applications for HIS** and other environments where nurses functioned.**
- **Conferences** helped public and home health nurses.**
- The opportunity to improve education using computer technology began.

1980s

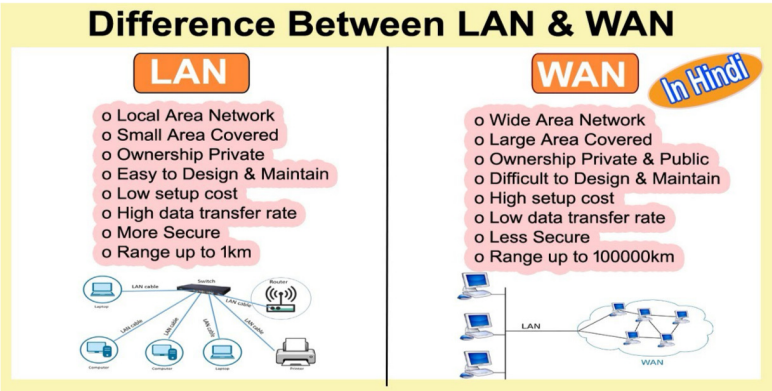
- field of **NI became visible** in the healthcare industry and nursing as well as many mainframe HIS emerged with nursing subsystems*
- **discharge planning** systems used as **referrals** and **microcomputer or personal computer emerged**
- in **1985**, the ANA approved the ***formation of the Council on Computer Applications in Nursing (CCAN)****

1990s

- NI became an integral part of health care settings, nursing practice and profession
- **policies and legislations were adopted** and nursing profession became actively involved in promoting NI
- **ANA approved NI as a new nursing specialty***
- laptops and notebooks
- LAN and WAN
- internet and www



1990s



2000s

- **data capture and data sharing** technological tools were developed
- ***wireless**, point-of-care, regional database projects and increased IT solutions
- use of **bar coding and radiofrequency identification**
- smaller mobile devices with wireless or internet access and **voice over internet protocol (VoIP)** example: Hey Siri

2010s

- genomic health care, shifting research paradigms and social technologies*
- complete digitalization in healthcare information**: **use of EHR**
- "**meaningful use**" Legislation***: meaning it's mandated for providers &/or hospitals, providing financial benefits who use EHR

There are three basic components of meaningful use:

- The use of a certified EHR in a meaningful manner.
- The electronic exchange of health information to improve quality of healthcare.
- The use of certified EHR technology to submit clinical quality and other measures.

The Meaning Use Criteria are driven by Health Outcomes Policy Priorities and Care Goals:

- Improve the quality, safety, efficiency of healthcare, and reduce health disparities.
- Engage patients and families.
- Improve care coordination.
- Improve public health.
- Ensure adequate privacy and security protections for PHI.

'**Meaningful Use**' is the general term for the ***Center of Medicare and Medicaid's (CMS's)*** electronic health record (EHR) incentive programs that provide financial benefits to healthcare providers who use appropriate EHR technologies in meaningful ways; ways that benefit patients and providers alike. Meaningful use is mandated for providers and hospitals to **improve quality, safety, communication, and coordination in healthcare.**

Landmark Events in Nursing & Computers

Year	Event/ Title	Place
1993	Formation of NI fellowship program	Boston, MA
1995	First international NI Teleconference	Australia, New Zealand & Maryland
1996	Telenurse Project	Denmark
2002	American Academy of Nursing initiated: expert panel on informatics	Naples, Florida
2004	First NI symposium at HIMSS	Orlando, Florida
2006	First TIGER Summit	Bethesda, MD
2006 & 2008	Symposium on Nursing Informatics, Brazil Medical Informatics Society	
2013/ 2014/ 2015	Big Data for Better Health Care Invitational Conference at University of Minnesota School of Nursing	

Nursing Informatics Philippine Perspective

Year	Events
1998	Birth of National Telehealth Center in UP
1999	NI started when PNA joined the Development of Standards for Health Information
2000	E-Health was recognized
2009	Nursing Informatics started to be offered in BSN in lieu of Basic in Computer
2010	Philippine Nursing Informatics Association was formed
2012	Informatics Nurses Society of the Philippines

Patient Safety and NI

- patient safety is the biggest factor that drives information technology

Some initiatives & legislations:

- CPOE - Computerized Provider Order Entry
- HIPAA - Health Insurance Portability and Accountabilty Act
- NAHIT - National Alliance for Health Information Technology

Computerized Provider Order Entry: The Basics

- Refers to the process of providers entering and sending treatment instructions.
- CPOE has several benefits:
  - Reduce errors and improve patient safety.
  - Improve efficiency.
  - Improve reimbursements.

Health Insurance Portability and Accountability Act

- A federal law required the creation of national standards to **protect sensitive patient health information** from being disclosed without the patient's consent or knowledge.

National Alliance for Health Information Technology

- was formed in **2002** in an effort to promote the use of health IT.
- Its members consisted of health care providers, payers, pharmaceutical companies and other industry organizations

Information Technology

- a set of related fields that encompass computer systems, software, programming languages and data and information processing and storage. IT forms part of **information and communications technology (ICT).**

Barcode-Assisted Medication Administered (BCMA)

- *verifies that the right drug is being administered to the right patient at the right dose by the right route at the right time
- **2 unique patient identifiers (JCAHO)**

Automated Dispensing Cabinets

- computerized point of use of **medication management system***
- allow the nurse to **obtain patient specific medications from drawers** or bins that open after a drug is chosen from a pick list**

Common "look-alike, sound-alike" medicine errors

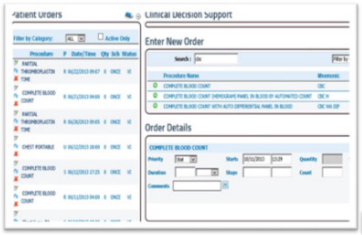
Amlodipine	Amitriptyline
Gabapentin	Pregabalin
Atenolol	Allopurinol
Atorvastatin	Amlodipine
Bisoprolol	Bendroflumethiazide
Enalapril	Escitalopram

Smart Infusion Pump Delivery Systems

- used to **deliver parenteral medications** through **IV or epidural lines**
- found in a variety of clinical settings*
- programmed with patient and drug parameters
- causes of errors in using the general/traditional pumps**
  - unintentional free flow of the solution*
  - error in programming**
  - incorrect, inappropriate or miscalculation

Computerized Physician Order Entry (CPOE)

- used for direct entry of one or more types of medical orders by a prescriber into a system*
- Allows to access records and enter orders remotely
- Includes passive and active feedback systems**
- advantages
  - improves quality, patient outcomes, and safety*
  - reduces variation in care to improve disease management**
  - improves drug prescribing and administration***



Physiologic Monitoring Systems (VITAL SIGNS)

1960s
the systems were **developed by NASA** to oversee the vital signs of the astronauts

1970s
the systems were found in **hospital setting** replacing the manual methods of gathering patients' vital signs

1980s
the technology became **cheaper, smaller and significantly more powerful**

1990s
the development was focused on **integration of monitoring data into information systems**

Critical Care Information System (CCIS)
- designed to collect, store, organize, retrieve, and manipulate all data related to the care of a **critically-ill patient**

- **primary purpose:**
  - organization of critically-ill patient's current and historical data for use by all care providers in patient care

CCIS Components
1. Patient Management
2. Vital Signs Monitoring
3. Diagnostic Testing Results
4. Clinical Documentation
5. Decision Support
6. Medication Management
7. Interdisciplinary Plans of Care
8. Provider Order Entry

Physiologic Monitoring Systems Basic Components
1. **Sensor** - ***Detects body signals*** and converts them to electrical signals.
2. **Signal Conditioner** - ***Strengthens and cleans*** the signal.
3. **File** - **Stores the data.**
4. **Computer Processor** - **Analyzes the data.**
5. **Evaluation or Controlling Component** - ***Triggers alarms or controls actions.***

Uses of Hemodynamic Monitors (cardio)
- measure hemodynamic parameters
- closely **examine cardiovascular problems**
- evaluate **cardiac pumps and volume status**
- **recognize patterns*** and extract features
- *assess vascular system integrity*
- evaluate the patient's physiologic *response to stimuli*
- continuously **assess respiratory gases**
- continuously **evaluate blood gases and electrolytes**
- **estimate cellular oxygenation**
- continuously **evaluate glucose levels**
- **automatically transmit selected data to a computerized patient database**

Non - Invasive Hemodynamic
- **Oscillometric** – Automatic BP via cuff.
- **Pulse Oximeter** – Measures SpO_2.
- **Doppler** – Ultrasound for blood flow/BP.

Invasive Hemodynamic Monitors
Pulmonary Artery Catheter – Measures pulmonary artery pressure
Thermistor – Measures temp for cardiac output.
Fiber-optic – measures the mixed venous oxygen saturation

Community Health Nursing
- a synthesis of nursing practice and public health practice applied to **promote and preserve the health of populations**

- **focus: population as a whole**

Computer Applications in CHN
- population focused
- continuity of care needs
- billing of services

Computer System Development in Community Health Nursing
(1970s)
CHN agencies have used computers since the late 1960s (1970s) when computers were introduced into the healthcare industry

advancements led to **four domains of concentration***

- **public health**: **population interventions** and outcomes
- **home health**: **skilled nursing care** and the outcomes
- **special population community practices: specific diagnostic care/ treatments** and outcomes
- **outpatient care: intermittent, episodic or preventive care** and outcomes

Community Health System
- refer to computerized IT systems specifically **developed and designed for use by community health agencies**, local and state health departments, community programs, and services

Some of the Typically Used Systems
1. **Categorical Program Systems**
- designed to support data processing and tracking specific programs such as cancer detection, mother and child immunization, and/or family planning

2. **Screening Programs**
- used to detect individuals with a specific disease or predisposing health conditions.

3. **Registration Systems**
- designed to identify patients eligible for CHN services in clinics and homes
- can be **accessed from local/district units** prior to providing services

4.Management information System
- focus on the **management statistical and operational needs** of the agency and professionals

5. Statistical Reporting
- developed to **collect and process statistical information** for health departments

6. Special Purpose System
- developed to **collect statistical data for administering a specific program, regardless of what type of agency offers the program**

7. Public Health Information Network
- enables **consistent exchange of response, health, and disease tracking data** between public health partners

MODERN SYSTEMS
1. Automated IV PUMPS
- **control the dosages and drips given to patients.** Software and medical tech allows nurses to change the drip amounts and medication doses so patients aren't waiting for changes. There are IV pumps for nutrition that give needed meals at the right times.

2. Portable Monitors
- Equipment **allows nursing professionals to check on patients, even if they're on the move or busy helping someone else**. Portable devices monitor vital signs like **ECG, respiratory rates, and oxygen saturations** while **transmitting the information back to a central monitor.**

3. Smart Bed Technology
- can help nurses **track movement, weight, and even vitals**. Smart beds also play a major role in keeping patients safe and comfortable during a long hospital stay. With the number of falls and patient injuries inside hospitals, smart beds are very important for patient safety. Smart bed technology gives nurses a constant in-room monitor that provides them with regular updates and communications on a patient's activities.

4. Wearable Devices
- Devices that help **track heart rates, exercise, sleep, respiration**, and more are **helping people take their health into their own hands.**
- With increased accessibility to iPhones, nurses also benefit from apps and devices that help them care for patients.

5. Electronic Health Record
- are **replacing older paper filing methods.** Electronic Health Records allow nursing experts to document care provided to patients and retrieve information that can help prioritize care.

6. Centralized Command Centers
- - improved patient experiences and better ways for RNs and doctors to manage supplies, clinical technology, and capacity. This is done through software applications such as dashboards that **provide real-time updates.**

7. Telehealth Apps
- is a **valuable, newer element in healthcare.** Hospitals and clinics allow patients to **virtually video chat with a doctor or nurse** to describe their symptoms or show doctors things like rashes or bumps. This helps patients with a **quick diagnosis without leaving the comfort of their own home.**