chapter 2

Introduction to Information, Information Science, and Information Systems

Dee McGonigle, Kathleen Mastrian, and Craig McGonigle

OBJECTIVES

1. Reflect on the progression from data to information to knowledge.
2. Describe the term *information*.
3. Assess how information is acquired.
4. Explore the characteristics of quality information.
5. Describe an information system.
6. Explore data acquisition or input and processing or retrieval, analysis, and synthesis of data.
7. Assess output or reports, documents, summaries, alerts, and outcomes.
8. Describe information dissemination and feedback.
9. Define information science.
10. Assess how information is processed.
11. Explore how knowledge is generated in information science.

Introduction

This chapter explores information, information systems (IS), and information science. The key word here, of course, is *information*. Health care professionals are **knowledge workers**, and they deal with information on a daily basis. Many concerns and issues arise with health care information, such as ownership, access, disclosure, exchange, security, privacy, disposal, and dissemination. With

Key Terms

Acquisition
Alert
Analysis
Chief information officer
Chief technical officer
Chief technology officer
Cloud computing
Cognitive science
Communication science
Computer-based information system
Computer science
Consolidated Health Informatics
Data
Dissemination
Document
Electronic health record

(continues)

Key Terms (continued)

- Federal Health Information Exchange
- Feedback
- Health information exchange
- Health Level 7
- Indiana Health Information Exchange
- Information
- Information science
- Information system
- Information technology
- Input
- Interface
- Internet2
- Knowledge
- Knowledge worker
- Library science
- Massachusetts Health Data Consortium
- National Health Information Infrastructure
- Nationwide Health Information Network
- New England Health EDI Network
- Next-Generation Internet
- Outcome
- Output
- Processing
- Rapid Syndromic Validation Project
- Report
- Social sciences
- Stakeholder
- Summaries
- Synthesis
- Telecommunications

the gauntlet of developing **electronic health records** (EHR) having been laid down, public and private sector stakeholders have been collaborating on a wide-ranging variety of health care information solutions. These initiatives include **Health Level 7** (HL7), the eGov initiative of **Consolidated Health Informatics'** (CHI's), the **National Health Information Infrastructure** (NHII), the **Nationwide Health Information Network** (NHIN), **Next-Generation Internet** (NGI), **Internet2**, and iHealth record. There are also **health information exchange** (HIE) systems, such as Connecting for Health, the eHealth initiative, the **Federal Health Information Exchange** (FHIE), the **Indiana Health Information Exchange** (IHIE), the **Massachusetts Health Data Consortium** (MHDC), the **New England Health EDI Network** (NEHEN), the State of New Mexico **Rapid Syndromic Validation Project** (RSVP), the Southeast Michigan e-Prescribing Initiative, and the Tennessee Volunteer eHealth Initiative (Goldstein, Groen, Ponkshe, & Wine, 2007). The most recent federal government initiative, the HITECH Act, set 2014 as the deadline for implementing electronic health records, yet clinics, private practices, and hospitals continue to struggle with the implementation and/or use of their electronic health records (for an overview of HIPAA and HITECH legislation, see Chapter 5).

It is evident from the previous brief listing that there is a need to remedy health care **information technology** concerns, challenges, and issues faced today. One of the main issues deals with how health care information is managed to make it meaningful. It is important to understand how people obtain, manipulate, use, share, and dispose of this information. This chapter deals with the information piece of this complex puzzle.

Information

Suppose someone states the number 99.5. What does that mean? It could be a radio station or a score on a test. Now suppose someone says that Ms. Howsunny's temperature is 99.5°F—what does that convey? It is then known that 99.5 is a person's temperature. The data (99.5) were processed to the information that 99.5° is a specific person's temperature. **Data** are raw facts. Information is processed data that have meaning. Health care professionals constantly process data and information to provide the best possible care for their patients.

Many types of data exist, such as alphabetic, numeric, audio, image, and video data. Alphabetic data refer to letters, numeric data refer to numbers, and alphanumeric data combine both letters and numbers. This includes all text and the numeric outputs of digital monitors. Some of the alphanumeric data encountered by health care professionals are in the form of patients' names, identification numbers, or medical record numbers. Audio data refer to sounds, noises, or tones, such as monitor alerts or alarms, taped or recorded messages, and other sounds. Image data include graphics and pictures, such as graphic monitor displays or recorded electrocardiograms, radiographs, magnetic resonance imaging outputs, and computed tomography (CT) scans. Video data refer to animations, moving pictures, or moving graphics, such as a physical therapist's video of a patient. Using these data, one may review the ultrasound of a pregnant patient, examine a patient's echocardiogram, watch an animated video for professional development, or learn how to operate a new technology tool, such as a pump or a monitoring system. The data we gather, such as heart and lung sounds or X-rays, help us produce information. For example, if a patient's X-rays show a fracture, it is interpreted into information, such as spiral, compound, or hairline. This information is then processed into knowledge, and a treatment plan is formulated based on the health care professional's wisdom.

The integrity and quality of the data rather than the form are what matter. Integrity refers to whole, complete, correct, and consistent data. Data integrity can be compromised through human error; viruses, worms, or other computer bugs; hardware failures or crashes; transmission errors; or hackers entering the system. Information technologies help to decrease these errors by putting into place safeguards, such as backing up files on a routine basis, error detection for transmissions, and user **interfaces** that help people enter the data correctly. High-quality data are relevant and accurately represent their corresponding concepts. Data are dirty when a database contains errors, such as duplicate, incomplete, or outdated records. One author (D.M.) found 50 cases of tongue cancer in a database she examined for data quality. When the records were tracked down and analyzed and the dirty data removed, only one case of tongue cancer remained. In this situation, the data for the same person had been entered erroneously 49 times. The major problem was with the patient's identification number and name: The number was changed, or his name was misspelled repeatedly. If researchers had just taken the number of cases in that defined population as 50, they would have concluded that tongue cancer was an epidemic, resulting in flawed information that is not meaningful. As this example demonstrates, it is imperative that data be clean if the goal is quality information. The data that are processed into information must be of high quality and integrity to create meaning to inform our practice.

To be valuable and meaningful, information must be of good quality. Its value relates directly to how the information informs decision making. Characteristics of valuable, quality information include accessibility, security, timeliness, accuracy, relevancy, completeness, flexibility, reliability, objectivity, utility, transparency, verifiability, and reproducibility.

Accessibility is a must; the right user must be able to obtain the right information at the right time and in the right format to meet his or her needs. Getting meaningful information to the right user at the right time is as vital as generating the information in the first place. The right user refers to an authorized user who has the right to obtain the data and information he or she is seeking. Security is a major challenge because unauthorized users must be blocked while the authorized user is provided with open, easy access (see Chapter 9).

Timely information means that the information is available when it is needed for the right purpose and at the right time. Knowing who won the lottery last week does not help one to know if the person won it today. Accurate information means that there are no errors in the data and information. Relevant information is a subjective descriptor in that the user must have information that is relevant or applicable to his or her needs. If a health care provider is trying to decide whether a patient needs insulin and only the patient's CT scan information is available, this information is not relevant for that current need. However, if one needs information about the CT scan, the information is relevant.

Complete information contains all of the necessary essential data. If the health care provider needs to contact the only relative listed for the patient and his or her contact information is listed but the approval for that person to be a contact is missing, this information is considered incomplete. Flexible information means that the information can be used for a variety of purposes. Information concerning the inventory of supplies in a clinic, for example, can be used by health care personnel who need to know if an item is available for use. The manager of the clinic accesses this information to help decide which supplies need to be ordered, to determine which items are used most frequently, and to do an economic assessment of any waste.

Reliable information comes from reliable or clean data gathered by authoritative and credible sources. Objective information is as close to the truth as one can get; it is not subjective or biased but rather is factual and impartial. If someone states something, it must be determined whether that person is reliable and whether what he or she is stating is objective or tainted by his or her own perspective.

Utility refers to the ability to provide the right information at the right time to the right person for the right purpose. Transparency allows users to apply their intellect to accomplish their tasks while the tools housing the information disappear. Verifiable information means that one can check to verify or prove that the information is correct. Reproducibility refers to the ability to produce the same information again.

Information is acquired either by actively looking for it or by having it conveyed by the environment. All of the senses (vision, hearing, touch, smell, and taste) are used to gather input from the surrounding world, and as technologies mature, more and more **input** will be obtained through the senses. Currently, people receive information from computers (output) through vision, hearing, or touch (input), and the response (output) to the computer (input) is the interface with technology. Gesture recognition is increasing, and interfaces that incorporate it will change the way people become informed. Many people access the Internet on a daily basis seeking information or imparting information. Individuals are constantly becoming informed, discovering, or learning; becoming re-informed, rediscovering, or relearning; and purging what has been acquired. The information acquired through these processes is added to the knowledge base. **Knowledge** is the awareness and understanding of a set of information and ways that information can be made useful to support a specific task or arrive at a decision. This knowledge building is an ongoing process engaged in while a person is conscious and going about his or her normal daily activities.

Information Science

Information science has evolved over the last 50 some years as a field of scientific inquiry and professional practice. It can be thought of as the science of information, studying the application and usage of information and knowledge in organizations and the interface or interaction between people, organizations, and IS. This extensive, interdisciplinary science integrates features from **cognitive science**, **communication science**, **computer science**, **library science**, and the **social sciences**. Information science is concerned primarily with the input, processing, output, and feedback of data and information through technology integration with a focus on comprehending the perspective of the **stakeholders** involved and then applying information technology as needed. It is systemically based, dealing with the big picture rather than individual pieces of technology.

Information science can also be related to determinism. Specifically, it is a response to technologic determinism—the belief that technology develops by its own laws, that it realizes its own potential, limited only by the material resources available, and must therefore be regarded as an autonomous system controlling and ultimately permeating all other subsystems of society (Web Dictionary of Cybernetics and Systems, 2007, para. 1).

This approach sets the tone for the study of information as it applies to itself, the people, the technology, and the varied sciences that are contextually related depending on the needs of the setting or organization; what is important is the interface between the stakeholders and their systems and the ways they generate, use, and locate information. According to Cornell University (2010), "Information Science brings together faculty, students and researchers who share an interest in combining computer science with the social sciences of how people and society interact with information" (para. 1). Information science is an interdisciplinary, people-oriented field that explores and enhances the interchange of information to transform society, communication science, computer science, cognitive science, library science, and the social sciences. Society is dominated by the need for information, and knowledge and information science focuses on systems and individual users by fostering user-centered approaches that enhance society's information capabilities, effectively and efficiently linking people, information, and technology. This impacts the configuration and mix of organizations and influences the nature of work—namely, how knowledge workers interact with and produce meaningful information and knowledge.

Information Processing

Information science enables the processing of information. This processing links people and technology. Humans are organic information systems, constantly acquiring, processing, and generating information or knowledge in their professional and personal lives. This high degree of knowledge, in fact, characterizes humans as extremely intelligent organic machines. The premise of this text revolves around this concept, and the text is organized on the basis of the Foundation of Knowledge model: knowledge **acquisition**, knowledge processing, knowledge generation, and knowledge dissemination.

Information is data that are processed using knowledge. For information to be valuable or meaningful, it must be accessible, accurate, timely, complete, cost effective, flexible, reliable, relevant, simple, verifiable, and secure. Knowledge is the awareness and understanding of an information set and ways that information can be made useful to support a specific task or arrive at a decision. As an example, if an architect were going to design a building, part of the knowledge necessary for developing a new building would be understanding how the building will be used, what size of building is needed compared to the available building space, and how many people will have or need access to this building. Therefore, the work of choosing or rejecting facts based on their significance or relevance to a particular task, such as designing a building, is also based on a type of knowledge used in the process of converting data into information.

Information can then be considered data made functional through the application of knowledge. The knowledge used to develop and glean knowledge from valuable information is generative (having the ability to originate and produce or generate) in nature. Knowledge must also be viable. Knowledge viability refers to applications that offer easily accessible, accurate, and timely information obtained from a variety of resources and methods and presented in a manner so as to provide the necessary elements to generate knowledge.

Information science and computational tools are extremely important in enabling the processing of data, information, and knowledge in health care. In this environment, the hardware, software, networking, algorithms, and human organic ISs work together to create meaningful information and generate knowledge. The links between information processing and scientific discovery are paramount. However, without the ability to generate practical results that can be disseminated, the processing of data, information, and knowledge is for naught. It is the ability of machines (inorganic ISs) to support and facilitate the functioning of people (human organic ISs) that refines, enhances, and evolves practice by generating knowledge. This knowledge represents five rights: the right information, accessible by the right people in the right settings, applied the right way at the right time.

An important and ongoing process is the struggle to integrate new knowledge and old knowledge so as to enhance wisdom. Wisdom is the ability to act appropriately; it assumes actions directed by one's own wisdom. Wisdom uses knowledge and experience to heighten common sense and insight to exercise sound judgment in practical matters. It is developed through knowledge, experience, insight, and reflection. Wisdom is sometimes thought of as the highest form of common sense, resulting from accumulated knowledge or erudition (deep, thorough learning) or enlightenment (education that results in understanding and the dissemination of knowledge). It is the ability to apply valuable and viable knowledge, experience, understanding, and insight while being prudent and sensible. Knowledge and wisdom are not synonymous because knowledge abounds with others' thoughts and information, whereas wisdom is focused on one's own mind and the synthesis of one's own experience, insight, understanding, and knowledge.

If clinicians are inundated with data without the ability to process it, the situation results in too much data and too little wisdom. Consequently, it is crucial that clinicians have viable ISs at their fingertips to facilitate the acquisition, sharing, and use of knowledge while maturing wisdom; this process leads to empowerment.

Information Science and the Foundation of Knowledge

Information science is a multidisciplinary science that encompasses aspects of computer science, cognitive science, social science, communication science, and library science to deal with obtaining, gathering, organizing, manipulating, managing, storing, retrieving, recapturing, disposing of, distributing, and broadcasting information. Information science studies everything that deals with information and can be defined as the study of ISs. This science originated as a subdiscipline of computer science as practitioners sought to understand and rationalize the management of technology within organizations. It has since matured into a major field of management and is now an important area of research in management studies. Moreover, information science has expanded its scope to examine the human–computer interaction, interfacing, and interaction of people, ISs, and corporations. It is taught at all major universities and business schools worldwide.

Modern-day organizations have become intensely aware of the fact that information and knowledge are potent resources that must be cultivated and honed to meet their needs. Thus, information science or the study of ISs—that is, the application and usage of knowledge—focuses on why and how technology can be put to best use to serve the information flow within an organization.

Information science impacts information interfaces, influencing how people interact with information and subsequently develop and use knowledge. The information a person acquires is added to his or her knowledge base. Knowledge is the awareness and understanding of an information set and ways that information can be made useful to support a specific task or arrive at a decision.

Health care organizations are affected by and rely on the evolution of information science to enhance the recording and processing of routine and intimate information while facilitating human-to-human and human-to-systems communications, delivery of health care products, dissemination of information, and enhancement of the organization's business transactions. Unfortunately, the benefits and enhancements of information science technologies have also brought to light new risks, such as glitches and loss of information and hackers who can steal identities and information. Solid leadership, guidance, and vision are vital to the maintenance of cost-effective business performance and cutting-edge, safe information technologies for the organization. This field studies all facets of the building and use of information. The emergence of information science and its impact on information have also influenced how people acquire and use knowledge.

Information science has already had a tremendous impact on society and will undoubtedly expand its sphere of influence further as it continues to evolve and innovate human activities at all levels. What visionaries only dreamed of is now possible and part of reality. The future has yet to fully unfold in this important arena.

Introduction to Information Systems

Consider the following scenario: You have just been hired by a large health care facility. You enter the personnel office and are told that you must learn a new language to work on the unit where you have been assigned. This language is used just on this unit. If you had been assigned to a different unit, you would have to learn another language that is specific to that unit and so on. Because of the differences in various units' languages, interdepartmental sharing and information exchange (known as interoperability) are severely hindered.

This scenario might seem far-fetched, but it is actually how workers once operated in health care—in silos. There was a system for the laboratory, one for finance, one for clinical departments, and so on. As health care organizations have come to appreciate the importance of communication, tracking, and research, however, they have developed integrated **information systems** that can handle the needs of the entire organization.

Information and information technology have become major resources for all types of organizations, and health care is no exception (see **Box 2-1**). Information technologies help to shape a health care organization, in conjunction with personnel, money, materials, and equipment. Many health care facilities have hired **chief information officers** (CIOs) or **chief technical officers** (CTOs), also known as **chief technology officers**. The CIO is involved with the information technology infrastructure, and this role is sometimes expanded to include the position of chief knowledge officer. The CTO is focused on organizationally based scientific and technical issues and is responsible for technological research and development as part of the organization's products and services. The CTO and CIO must be visionary leaders for the organization because so much of the business of health care relies on solid infrastructures that generate potent and timely information and knowledge. The CTO and CIO are sometimes interchangeable positions, but in some organizations the CTO reports to the CIO. These positions will become critical roles as companies continue to shift from being product oriented to knowledge oriented and as they begin emphasizing the production process itself rather than the product. In health care, ISs must be able to handle the volume of data and information necessary to generate the needed information and knowledge for best practices because the goal is to provide the highest quality of patient care.

Information Systems

Information systems can be manually based, but for the purposes of this text, the term refers to **computer-based information systems** (CBISs). According to Jessup and Valacich (2008), computer-based ISs "are combinations of hardware, software and telecommunications networks that people build and use to collect, create, and distribute useful data, typically in organizational settings" (p. 10). Along the same lines, ISs are also defined as a collection of interconnected elements that gather, process, store and distribute data and information while providing a feedback structure to meet an objective

(Stair & Reynolds, 2016). ISs are designed for specific purposes within organizations. They are only as functional as the decision-making capabilities, problem-solving skills, and programming potency built in and the quality of the data and information input into them (see Chapter 6). The capability of the IS to disseminate, provide feedback, and adjust the data and information based on these dynamic processes is what sets them apart. The IS should be a user-friendly entity that provides the right information at the right time and in the right place.

BOX 2-1 EXAMPLES OF INFORMATION SYSTEMS

An IS acquires data or inputs; processes data through the retrieval, **analysis**, or **synthesis** of those data; disseminates or outputs information in the form of reports, documents, summaries, alerts, prompts, or outcomes; and provides for responses or feedback. Input or data acquisition is the activity of collecting and acquiring raw data. Input devices include combinations of hardware, software, and **telecommunications**, including keyboards, light pens, touchscreens, mice or other pointing devices, automatic scanners, and machines that can read magnetic ink characters or lettering. To watch a pay-per-view movie, for example, the viewer must first input the chosen movie, verify the purchase, and have a payment method approved by the vendor. The IS must acquire this information before the viewer can receive the movie.

Processing—the retrieval, analysis, or synthesis of data—refers to the alteration and transformation of the data into helpful or useful information and outputs. The processing of data includes storing it for future use; comparing the data, making calculations, or applying formulas; and taking selective actions. Processing devices consist of combinations of hardware, software, and telecommunications and include processing chips where the central processing unit and main memory are housed. Some of these chips are quite ingenious. According to Schupak (2005), the bunny chip could save the pharmaceutical industry money while sparing "millions of furry creatures, with a chip that mimics a living organism" (para. 1). The HμREL Corporation has developed environments or biologic ISs that reside on chips and actually mimic the functioning of the human body. Researchers can use these environments to test for both the harmful and beneficial effects of drugs, including those that are considered experimental and that could be harmful if used in human and animal testing. Such chips also allow researchers to monitor a drug's toxicity in the liver and other organs.

One patented HμREL microfluidic "biochip" comprises an arrangement of separate but fluidically interconnected "organ" or "tissue" compartments. Each compartment contains a culture of living cells drawn from or engineered to mimic the primary functions of the respective organ or tissue of a living animal. Microfluidic channels permit a culture medium that serves as a "blood surrogate" to recirculate just as in a living system, driven by a microfluidic pump. The geometry and fluidics of the device are fashioned to simulate the values of certain related physiologic parameters found in the living creature. Drug candidates or other substrates of interest are added to the culture medium and allowed to recirculate through the device. The effects of drug compounds and their metabolites on the cells within each respective organ compartment are then detected by measuring or monitoring key physiologic events. The cell types used may be derived from either standard cell culture lines or primary tissues (HμREL Corporation, 2010, paras. 2–3). As new technologies such as the HμREL chips continue to evolve, more and more robust ISs that can handle a variety of biological and clinical applications will be seen.

Returning to the movie rental example, the IS must verify the data entered by the viewer and then process the request by following the steps necessary to provide access to the movie that was ordered. This processing must

(*continues*)

BOX 2-1 EXAMPLES OF INFORMATION SYSTEMS (continued)

be instantaneous in today's world, where everyone wants everything *now*. After the data are processed, they are stored. In this case, the rental must also be processed so that the vendor receives payment for the movie, whether electronically, via a credit card or checking account withdrawal, or by generating a bill for payment.

Output or **dissemination** produces helpful or useful information that can be in the form of reports, documents, summaries, alerts, or outcomes. **Reports** are designed to inform and are generally tailored to the context of a given situation or user or user group. Reports may include charts, figures, tables, graphics, pictures, hyperlinks, references, or other documentation necessary to meet the needs of the user. **Documents** represent information that can be printed, saved, e-mailed or otherwise shared, or displayed. **Summaries** are condensed versions of the original designed to highlight the major points. **Alerts** are warnings, feedback, or additional information necessary to assist the user in interacting with the system. **Outcomes** are the expected results of input and processing. **Output** devices are combinations of hardware, software, and telecommunications and include sound and speech synthesis outputs, printers, and monitors.

Continuing with the movie rental example, the IS must be able to provide the consumer with the movie ordered when it is wanted and somehow notify the purchaser that he or she has, indeed, purchased the movie and is granted access. The IS must also be able to generate payment either electronically or by generating a bill while storing the transactional record for future use.

Feedback or responses are reactions to the inputting, processing, and outputs. In ISs, feedback refers to information from the system that is used to make modifications in the input, processing actions, or outputs. In the movie rental example, what if the consumer accidentally entered the same movie order three times but really wanted to order the movie only once? The IS would determine that more than one movie order is out of range for the same movie order at the same time and provide feedback. Such feedback is used to verify and correct the input. If undetected, the viewer's error would result in an erroneous bill and decreased customer satisfaction while creating more work for the vendor, which would have to engage in additional transactions with the customer to resolve this problem. The *Nursing Informatics Practice Applications: Care Delivery* section of this text provides detailed descriptions of clinical ISs that operate on these same principles to support health care delivery.

Summary

Information systems deal with the development, use, and management of an organization's information technology infrastructure. An IS acquires data or inputs; processes data through the retrieval, analysis, or synthesis of those data; disseminates or outputs in the form of reports, documents, summaries, alerts, or outcomes; and provides for responses or feedback. Quality decision-making and problem-solving skills are vital to the development of effective, valuable ISs. Today's organizations now recognize that their most precious asset is their information, as represented by their employees, experience, competence or know-how, and innovative or novel approaches, all of which are dependent on a robust information network that encompasses the information technology infrastructure.

In an ideal world, all ISs would be fluid in their ability to adapt to any and all users' needs. They would be Internet oriented and global, where resources are available to everyone. Think of **cloud computing**—it is just the beginning point from which ISs will expand and grow in their ability to provide meaningful information to their users. As technologies advance, so will the skills and capabilities to comprehend and realize what ISs can become.

It is important to continue to develop and refine functional, robust, visionary ISs that meet the current meaningful information needs while evolving systems that are even better prepared to handle future information and knowledge needs of the health care industry.

Thought-Provoking Questions

1. How do you acquire information? Choose 2 hours out of your busy day and try to notice all of the information that you receive from your environment. Keep diaries indicating where the information came from and how you knew it was information and not data.
2. Reflect on an IS with which you are familiar, such as the automatic banking machine. How does this IS function? What are the advantages of using this system (i.e., why not use a bank teller instead)? What are the disadvantages? Are there enhancements that you would add to this system?
3. In health care, think about a typical day of practice and describe the setting. How many times do you interact with ISs? What are the ISs that you interact with, and how do you access them? Are they at the patient's side, handheld, or station based? How does their location and ease of access impact patient care?
4. Briefly describe an organization and discuss how our need for information and knowledge impacts the configuration and interaction of that organization with other organizations. Also discuss how the need for information and knowledge influences the nature of

work or how knowledge workers interact with and produce information and knowledge in this organization.

5. If you could meet only four of the rights discussed in this chapter, which one would you omit and why? Also, provide your rationale for each right you chose to meet.

Apply Your Knowledge

Consider the following example of the relationship between data, information knowledge, and wisdom provided by Bellinger, Castro, and Mills (2004, para. 6).

Data represent a fact or statement of event without relation to other things.

Example: It is raining.

Information embodies the understanding of a relationship of some sort, possibly cause and effect.

Example: The temperature dropped 15 degrees, and then it started raining.

Knowledge represents a pattern that connects and generally provides a high level of predictability as to what is described or what will happen next.

Example: If the humidity is very high and the temperature drops substantially, the atmosphere is often unlikely to be able to hold the moisture so it rains.

Wisdom embodies more of an understanding of fundamental principles embodied within the knowledge that are essentially the basis for the knowledge being what it is. Wisdom is essentially systemic.

Example: It rains because it rains. And this encompasses an understanding of all the interactions that happen between raining, evaporation, air currents, temperature gradients, changes, and raining.

Select an example of data from your profession, and follow it through the DIKW paradigm as above.

References

Bellinger, G., Castro, D., & Mills, A. (2004). Data, information, knowledge, and wisdom. http://www.systems-thinking.org/dikw/dikw.htm

Cornell University. (2010). Information science. http://www.infosci.cornell.edu

Goldstein, D., Groen, P., Ponkshe, S., & Wine, M. (2007). *Medical informatics 20/20*. Sudbury, MA: Jones and Bartlett.

HμREL Corporation. (2010). Human-relevant: HμREL. Technology overview. http://www.hurelcorp.com/overview.php

Jessup, L., & Valacich, J. (2008). *Information systems today* (3rd ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Schupak, A. (2005). Technology: The bunny chip. http://members.forbes.com/forbes/2005/0815/053.html

Stair, R., & Reynolds, G. (2016). *Principles of information systems* (12th ed.). Boston: Cengage Learning.

Web Dictionary of Cybernetics and Systems. (2007). Technological determinism. http://pespmc1.vub.ac.be/ASC/TECHNO_DETER.html