

Philosophical Approaches to the Nursing Informatics Data-Information-Knowledge-Wisdom Framework

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Although informatics is an important area of nursing inquiry and practice, few scholars have articulated the philosophical foundations of the field or how these translate into practice including the often-cited data, information, knowledge, and wisdom (DIKW) framework. Data, information, and knowledge, often approached through postpositivism, can be exhibited in computer systems. Wisdom aligns with constructivist epistemological perspectives such as Gadamerian hermeneutics. Computer systems can support wisdom development. Wisdom is an important element of the DIKW framework and adds value to the role of nursing informaticists and nursing science. **Key words:** *constructivism, hermeneutics, information management, knowledge, nursing informatics, nursing, nursing research, objectivism, philosophy, postpositivism, qualitative research*

*Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?*

Thomas Stearns Eliot¹

EARLY definitions of nursing informatics (NI)² varied but soon coalesced around Graves and Corcoran's³ seminal article outlining data, information, and knowledge as foundational concepts for the specialty. Their conceptual framework has been widely accepted

throughout the international NI community. In 2008, the American Nurses Association (ANA) revised the Scope and Standards for Nursing Informatics to include an additional concept, wisdom, in the definition of nursing informatics.² Data, information, knowledge, and wisdom (DIKW) provide a foundational framework for NI and the framework is useful for the broader nursing community as well, providing a basis for linking theory and practice.

The philosophical foundations of this widely accepted framework have not been well described. The recognition of Graves and Corcoran's work and its worldwide adoption by the nursing informatics community, coupled with the more recent addition of the concept of wisdom, merit philosophical inquiry and clarification. Therefore, we describe the concepts of the data, information, knowledge, and wisdom (DIKW) framework and how they are used in nursing and NI. We explain two philosophical approaches, postpositivism and the hermeneutics of Hans-Georg

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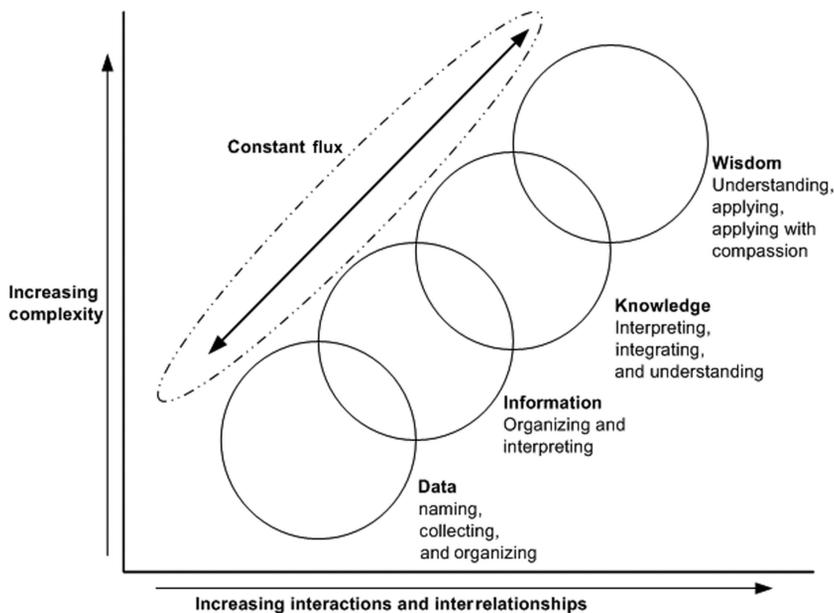


Figure 1. DIKW framework. Reprinted with permission from Nelson.¹⁷

Gadamer that collectively provide an epistemological basis for understanding the DIKW framework. We examine how each approach contributes conceptual clarity and structure for the DIKW framework as a foundation for nursing informatics. We provide NI and nursing examples of these perspectives, and discuss how DIKW can be useful in linking theory with practice.

DIKW FRAMEWORK IN NURSING

Informatics has been identified as one of the core competencies for nurses at all levels of practice, not just for informatics nurse specialists.^{2,4} Data, information, knowledge, and wisdom are considered overarching concepts (metastructures) supporting all of nursing and informatics practice. The DIKW concepts, often described as a hierarchy, originated in computer and information sciences, in particular, in the subspecialty of knowledge management.⁵ Figure 1 is the most current model adopted by nursing informatics, illustrating how the concepts build

upon each other, growing in scope and meaning as they become increasingly abstract and sophisticated.² ‘Fuzzy’ or overlapping boundaries exist at the juncture between each of the concepts. As a prelude to the philosophical discussion, the following section describes each DIKW concept in more detail.

DATA

Data are the smallest units in the DIKW framework. They are typically understood as symbols that represent objects, events, and their properties. Data come in many forms such as numbers, words, sentences, or pictures—they can be anything given, no matter what the origin or form.⁶ Data have been explained as the products of observation,⁷ discrete facts with a minimum of interpretation.³ Thus, a single piece of data (a *datum*) has little or no meaning in isolation. Data are the form most often stored within patient records, and are used as a basis for further reasoning, calculation, or discussion.

INFORMATION

Information may be thought of as “data plus meaning.” It can be derived by processing data.³ Information represents the facts and ideas that are available to be known within a certain context.⁸ When data are put into a context and combined within a structure, information emerges.⁹

Data and information are not discrete bits; rather, there is a continuum of progressively increased meaning and value.¹⁰ To describe an example of data becoming more meaningful information, consider the number “110.” The number has little meaning without context. When developed into a name-value pair, such as “heart rate = 110” (where heart rate is the name, and 110 beats per minute is the value), a meaning begins to emerge. The phrase “a heart rate of 110” increases in meaning when we know that the context is an older adult. Data and information not only represent physical observations, but may also represent abstract concepts such as depression, pain, spirituality, or psychosocial care.¹¹

Information answers questions that begin with basic words such as who, what, where, when, and how many. Information may be organized in ways that serve the interests of a discipline¹² and in practice, health information is organized in a way unique to the practice of nursing.

KNOWLEDGE

Just as data can be transformed into meaningful information, so too can information be transformed into knowledge. Knowledge is information that has been synthesized so that relationships are identified and formalized.³ Knowledge answers questions that begin with “how” and “why.”

There are many types of knowledge.¹³ Two types are described within the field of knowledge management: tacit and explicit. Tacit knowledge is difficult to summarize and communicate to others.¹⁴ It is personal, context-specific, and therefore hard to formalize.⁹ We

may call this “background” knowledge. Explicit knowledge, in contrast, can be generated and formalized, and is more amenable to encoding and transmitting in a formal manner. Explicit knowledge is what knowledge management systems (such as computer decision support systems) seek to capture, codify, store, transfer, and share.

Like the transformation of data to information, the transformation of information to knowledge in nursing and information systems can be conceptualized as a continuum of increasing understanding.¹⁰ Knowledge is derived by discovering patterns and relationships between types of information.

Consider the previous example of a patient with a heart rate of 110 beats per minute. If we combine this with additional information such as: this is a 70-year-old man with pneumonia, his blood pressure is 80/60 mm Hg and decreasing steadily from previous values, his temperature is 101°F, his respiratory rate is 30, his urine output has totaled 60 mL in the past 4 hours, and his skin is dry to the touch—then based on known physiologic patterns nurses will conclude that this person is exhibiting signs of dehydration caused by his fever and pneumonia, and he needs increased fluid intake. This exemplifies nursing knowledge. Similarly, knowledge may be exhibited when a nurse formulates a nursing diagnosis, such as spiritual distress, and identifies the potential interventions such as spiritual care or a clergy referral that could lead to a positive outcome.¹¹

WISDOM

The ANA defines *wisdom* as the appropriate use of knowledge to manage and solve human problems.² Beyond that, wisdom implies a form of ethics, that is, knowing why things should or should not be done in practice.¹⁵ It is not a fixed entity, but rather a reciprocal, action-oriented process.¹⁶ Wisdom involves recognizing what is most important, by making distinctions among alternatives. It comprises the application of experience,

intelligence, creativity, and knowledge, as mediated by values, toward the achievement of a common good.¹⁷ Benner¹⁸ bases the understanding of wisdom in nursing on clinical judgment and a thinking-in-action approach that encompasses intuition, emotions, and the senses. Yet, each of these extant definitions does not fully capture the complexity or sophistication of the concept.

There is an increased level of critical thinking at each level of the DIKW framework. Although the progression from knowledge to wisdom is not as straightforward as the path among the other concepts, wisdom builds on and uses knowledge. The difference between knowledge and wisdom is like the difference between memorizing and understanding—there is a process of internalization.

To continue our previous examples, wisdom is displayed when the nurse chooses a specific, tailored means of providing fluid to the elderly patient with pneumonia. The nurse who chooses a form of spiritual care, based perhaps on the preferences and inclinations of the patient, is also displaying wisdom.

PHILOSOPHICAL APPROACHES

There are different—at first glance even contradictory—philosophical approaches that inform and provide conceptual structure for the DIKW framework. Nursing has long recognized that there can be valuable contributions from theories emerging from different paradigms and epistemologies.¹⁹ At the intersection of philosophical paradigms and the exploration of the DIKW framework is the question: What is meant by “knowledge” and how does knowledge, in turn, support “wisdom?” That is, what is the appropriate application of knowledge to form wisdom? We argue that 2 distinct yet integrated epistemological approaches, the objectivist approach of *postpositivism* and the interpretive approach of *Gadamerian hermeneutics* (especially what Gadamer termed *practical philosophy*),²⁰ combine

to frame and illuminate how the DIKW functions as the basis of informatics inquiry and practice.

DEFINITIONS

The definitions and usages of philosophical terms have evolved over time, and nuances of those definitions remain the subject of philosophical debate. Many of the terms remain broadly defined and have fuzzy boundaries.²¹ Although acknowledging other definitions exist for these terms, and that other terms may fit these definitions, we begin with an explication of philosophical terms used here and the meaning we intend when using these terms. This explication provides the assumptions and foundation for the later discussion.

Epistemology is the study of the nature of knowledge. It is the philosophical grounding for deciding what kinds of knowledge are possible, “how we know what we know,”^{21(p4)} and how knowledge links with related concepts.^{21,22} Following Crotty,²¹ 2 common epistemological perspectives are objectivism and constructivism.

Objectivism is the epistemological perspective that things exist and have intrinsic meaning independent of human experience.²¹ It is the perspective of the world as an objective reality that can be discovered by an observer who is distinct from the thing observed.^{21,22} We understand *postpositivism* as an example of this perspective. Postpositivism in this article encompasses the basic assumptions of objectivism (such as intrinsic reality that can be discovered, researcher objectivity, and generalizability of findings) but acknowledges that scientific statements are tentative and contain a level of uncertainty and error.^{21,22} We chose this example because much of the nursing informatics literature has been approached from the perspective of postpositivism.

Constructivism is the epistemological perspective stating that meaning comes into existence through engagement with the world. This perspective suggests that meaning is

constructed as an interaction between humans and the world around them.^{21,22}

We use *Gadamerian hermeneutics* as an example of an approach arising from this epistemology. *Hermeneutics* is concerned with interpreting meaning based on a text, which may be written or recorded. Although there are many varieties of hermeneutics, Gadamer's approach was based on the centrality of language and dialogue to understanding, and that language is bound to history and traditions.^{21,22} We chose this example because the focus on language and communication is compatible with many nursing informatics roles and responsibilities.

POSTPOSITIVISM

The objectivist epistemology posits an understanding of science in which objects and phenomena have intrinsic meaning discoverable through observation.^{22,23} Truth and meaning are held to exist within the objects or phenomena, and are independent of human consciousness or experience.²¹ A researcher, or observer, is separate from the thing being observed. Detachment in the research process is desirable because meaning resides in the objects or phenomena themselves.^{21,22}

Comte used the term *positivism* to describe a strict application of the objectivist epistemology. Knowledge was viewed as being built from unbiased observations (objective data) through a logical process of induction to empirically verifiable conclusions.^{21,22} In positivism, all that is known must be experienced through the senses. Different observers should record the same results, or at least be able to repeat the same experiments. Once the facts have been established, the phenomenon under observation can be explained by reference to those facts.

Other philosophers have endorsed a less strict form of objectivism, which has evolved to become the currently prevailing approach to "classical" science. Although there have been several schools of thought that followed positivism, those that remain grounded pri-

marily in the objectivist epistemology are what we mean when we use the term *postpositivism*.^{21,22}

Unlike the certainty and claims of absolute truth within the positivist approach, Popper,²⁴ a 20th-century philosopher, suggested that scientific knowledge is probabilistic and fallibilistic in nature—that there is a level of uncertainty and error in science. He saw scientific knowledge as subject to further testing and possible falsification at some future date. Popper emphasized the influence of background knowledge on science, whereas postulating a need for the ongoing revision and criticism of scientific assumptions.²⁴ We can see Popper's influence in the methods of research reports today—for example, with statistical findings that include confidence levels and levels of significance. In information systems, uncertainty and error are acknowledged in decision support systems that employ probabilistic reasoning methods or "fuzzy logic" algorithms.

Kuhn²⁵ opened a still wider perspective onto the practice of what he called *puzzle solving* as representing what science does to generate knowledge. Like other postpositivists, Kuhn emphasized that observations are theory laden; that scientists are never completely detached and value free, but that they approach science out of a background of beliefs and theories.²¹ We can see Kuhn's influence, for example, when we witness the frequent efforts to "upgrade" standardized terminologies in response to changes in health care practices.

Postpositivist scientific theory has evolved and increasingly recognizes the significance of context for the understanding of meaning.²¹ The postpositivist approach acknowledges the social aspects of reality, accepting that what is "real" includes things that cannot be directly observed. Society, feelings, intelligence, spirituality, pain, and similar constructs are assumed to be just as real as physical observations, at least to the extent that they influence the observable world.²² Abstract concepts are "observable" through surrogate measures that reflect

the effects of the underlying reality on the senses. The rigorously formalized language of science—whether expressed symbolically as digits, codes, concepts, or statistical *P* values—is understood to refer to entities that are real and that are described accurately.

The postpositivistic approach nevertheless affirms that authentic knowledge comes from the truth of facts (data and information), derived through the use of strict scientific methods and controls. The facts that “count” are observable and objective.²⁶ Facts representing abstract concepts can be represented through observable surrogate measures.¹¹

A fundamental assumption of postpositivism is that data, information, and knowledge can be described accurately and can be created or imputed, stored, shared, and reused. For information and knowledge to be valid and generalizable, the data must be “clean,” or virtually independent of context-specific or individual interpretation. This assumption is exemplified in the use of data-cleaning operations prior to the permanent storage of data records in a clinical database or enterprise data warehouse. Use of shared definitions for data, and processes to support objectivity in collecting data, enable a certain degree of confidence that the meaning of data recorded in an electronic health record (EHR) can be known and shared. Clinicians and researchers may conclude that information and knowledge developed from this data will be accurate and can reliably support research, clinical nursing practice, and nursing decisions.

The progression from data to information and from information to knowledge, while not having discrete boundaries, is internally consistent and may be clearly demonstrated. The idea of evidence-based practice is built upon a predominantly objectivist epistemology, as are many of the practices related to patient safety and health care quality. Wisdom, defined as appropriate application of knowledge,² is also supported in the postpositivistic theoretical perspective. Wisdom is demonstrated in nursing decisions and actions. Wisdom, then, is illustrated when a

nurse determines whether a particular body of knowledge applies to the current patient, at the current time.

Early understandings of the DIKW framework within nursing informatics were described solely from within the assumptions of objectivist epistemology. Graves and Corcoran³ defined data as *discrete observations* described *objectively* (emphases ours). In this regard, we may also note that data entered into an EHR during the course of care are typically referred to as observations. Information is formed through aggregation or other replicable procedures. Knowledge is based on objective data and information, with little or no interpretation and minimal interference from human preconceptions.

Observations may be used for decision support (via the assertion of facts in decision support systems) and to determine if the criteria for evidence-based practice have been met. Individual patient data, evaluated against the knowledge that has been encoded in an evidence-based guideline, can help the nurse decide whether to act on the knowledge—thus illustrating nursing wisdom. Sophisticated clinical decision support systems can tailor recommendations to individual patient data, helping the nurse decide if a particular decision support recommendation is appropriate for this patient, at a particular time.

If information is assumed to have meaning that can be commonly understood, it follows logically, then, that nurse informaticists and clinical nurses should collaborate to define nursing data and ensure that the semantics of “concepts” stored in an EHR are collectively agreed upon. Standardized terminologies used in nursing include not only physical data, but also abstract concepts such as pain, coping, or spiritual distress.

Burkhart and Androwich¹¹ discuss measurement of spiritual care using data captured in an EHR. This article illustrates a postpositivist approach. The authors emphasize capturing data in such a way that they can be aggregated, optimally within structured documentation and preferably through quantitative measures such as Likert-type scales

(data) using standardized terminology with agreed upon definitions that are consistently applied (information). They discuss developing an instrument to consistently measure the abstract concept of spiritual health (knowledge), and discuss appropriate ways to apply the instrument such as during nursing assessments (wisdom). A philosophical question (explored further in the article) is: can standardized terms and objective instruments capture the deeper meaning of nurse-patient care situations?

GADAMERIAN HERMENEUTICS

Although the perspective of objectivism suggests that meaning is contained within objects and phenomena, *constructivism* is the epistemological perspective that meaning comes into existence through essentially social engagement. Meaning is constructed as an interaction between humans and the world around them.^{21,22}

There are many approaches within constructivism, including interpretive approaches that focus on constructing meaning through language. We will use *Gadamerian hermeneutics* as an example of an approach that emerges from this epistemology. Traditionally, *hermeneutics* has been considered as the art of interpretation and described as a method for understanding texts. There are multiple varieties of hermeneutics. Gadamer's approach is based on the centrality of language and dialogue to understanding, and the premise that language is bound to our history.^{21,22}

In Gadamerian hermeneutics, subjective ways of knowing take on a significant role. Gadamer explicitly thematizes the impact of the individual's background knowledge and the ways that preconceptions play an inextricable role in human judgment and practice. Without providing criteria for epistemological certainty beyond the assurance that participants in a dialogue know the truth of their hermeneutic situation implicitly and at every moment while being involved in this activity,

Gadamer replaces the theoretical concept of knowing with that of human understanding in practice.²⁷ Gadamer reframes the epistemological question of knowledge in the form, "How is *understanding* possible?"²⁸ and anticipates a response in the form of actively seeking an answer.

We focus on 2 central themes in Gadamer's work. One is the activity of developing understanding in the *hermeneutic circle*. Second is what Gadamer called "*the universality of hermeneutics*."²⁹

The hermeneutic circle is a back and forth interplay that makes us aware of the "preunderstandings"³⁰ that are essential to our understanding of the world.²⁷ Martin Heidegger, one of Gadamer's philosophical teachers, introduced the concept of the hermeneutic circle to elucidate the idea that understanding is a reciprocal activity. Further elaborating on this concept, Gadamer's hermeneutic approach was a way of focusing attention on the interpretation of experience in what he calls the 'hermeneutic situation', as found primarily within dialogue.³¹ Gadamerian hermeneutics concentrates on expanding meaning and shared understanding through dialogue, whether in a living conversation between persons or in the linguistic interplay that takes place between a reader and a text.

The nursing process might be thought of as a representation of the hermeneutic circle—from the flow of data collection and problem identification, through outcome measurements, which are a form of data collection. Documentation that links nursing diagnoses, interventions, and outcomes, tracks those links over time, and is evaluated and revised, also reflects a form of the hermeneutic circle.

In Gadamerian hermeneutics, everyday communication presupposes the historical existence of a language and a collectively shared tradition to which it belongs as a medium and repertoire of available meanings. Meaningfulness is codetermined by language and the context provided by tradition. What Gadamer calls tradition can be understood as

being the knowledge that is effective in the shared life-world of the participants in dialogue at any given place and time.³² Tradition, then, is background knowledge, available to us both tacitly and explicitly.

This life-world experience is the basis for what Gadamer called the “universality” of philosophical hermeneutics²⁹—the second central theme of focus. Universality is the idea that there is a common structure in human experience, as given through shared natural languages, which makes understanding possible. In human life-world contexts, something logically and temporally always precedes our conscious awareness or focused attention. For Gadamer, this “something” is language, which is a type of experience that is tacitly “known” to us from our everyday encounters and interactions in the world with others. Hermeneutic understanding relies on a continuous process of interpretation and translation of meaning within the linguistic world of common human experience.

Gadamer underscores the dimensions of language and effective history as the horizon of human experience.²⁸ The act of interpretation occurs through what Gadamer calls a fusion of horizons, which implies that the interpreter’s own horizon of expectation is a limit or boundary informing the act of interpretation, as well as that this limit is not permanent, static, or final. The hermeneutic fusion of horizons, in other words, is a dialectical process. When new understanding occurs, it is then possible for a type of learning to take place or rather, to emerge from a prior horizon of understanding. This process of learning involves a kind of trusting openness as a fundamental dimension of the interpreters’ shared approaches to experiencing the world, for example, through language and history. The more we practice interpretation and understanding, the more we improve at these processes. In everyday contexts, we often practice hermeneutic understanding unawares. In reading, we slow down and are implicitly asked by the subject matter and its degree of difficulty or “strangeness” to concentrate attentively.

Gadamer’s claim of hermeneutics’ “universality” in the context of the DIKW framework supports standardized terminology in that there are common human experiences that can be described, there are patterns that can be known, and language used to communicate those patterns. Research based in Gadamerian hermeneutics is needed to help identify those patterns. A philosophical question for nursing informatics is whether it is possible to communicate the full meaning of language within a standardized terminology. Meaning and judgment exist in the choice of a specific standard terminology to use in a health record—but how much of that meaning and judgment can be captured? From the perspective of Gadamerian hermeneutics, an unconscious dimension of understanding always exceeds our conceptual grasp. Thus, what language is saying beyond our intended meanings can never be completely controlled or formalized with absolute precision. The number of contexts-within-contexts-within-contexts (and so on. . .) involved in even the most common linguistic utterances is beyond finite human capabilities or understanding.

As opposed to the linear progression from data to knowledge in the empirical perspective, the hermeneutic approach to understanding (knowledge) is recursive and increasingly contextual and personal. The hermeneutic process presupposes that an interpreter must be able to understand the cultural and historical horizon of the person being understood as well as his or her own cultural biases and limitations.³³ Though hermeneutic criteria for the reasonableness of viewpoints and for the justification of arguments exist, these ideally ought to be agreed to by all the participants in the dialogue from the beginning.³⁴ What if the resulting understanding simply reinforces a group’s biases, rather than generating a new understanding that is aware of them? Hermeneutics’ version of fallibilism would suggest that the only answer in this situation is to return to the topic again at some other time, when the effect of biases may or may not be more clearly

recognized, and so on, in a potentially lengthy series of research studies. For Gadamer, the outcome of an authentic dialogue can never be predetermined in advance.

Interpretation becomes especially important in orienting practice when meaning becomes elusive or difficult to grasp, or when a consensus needs to be reestablished within a group or team. We see in Gadamerian hermeneutics the emergence and importance of practical wisdom (*praxis*), as a dimension that is not simply identical with institutional norms and professional guidelines (as Kuhn and a number of sociologists of knowledge might seem to imply).²⁷ Understanding how wisdom is present in day-to-day tasks can be challenging, even for the most experienced practitioner. Gadamer taught that arriving at this understanding might involve reentering the hermeneutic circle from a different angle, or along a different “learning curve,” for example, going back and reviewing what our preunderstandings were, as we discover how understanding may continue to grow and become translated into practical wisdom.

Interpretive approaches such as Gadamerian hermeneutics certainly include data and information (eg, the words on the page, the “what” of the subject matter being discussed). They focus our attention on the importance of context in developing knowledge or understanding from the ground up, for example, by foregrounding the significance of life-world experience. The references to “tacit knowledge”³⁵ in many explications of the DIKW framework confirm the potential significance and importance of the interpretive dimension and of its discernible ties to personal values and ethics.

As we become more and more versed in the art of understanding through hermeneutic *praxis*—whether it be through encounters with patients in a clinical setting or taking night-school classes in how to read poetic literature—we become experienced in the ability to ask the right questions and to receive meaningful answers. Expressly translated from the experience of the hermeneu-

tic circle back into daily life-world activity (or *praxis*), this ability is what Aristotle called *phronesis*, or practical wisdom. Practical wisdom enables ethical action that contributes to the common good, by allowing us to recognize and then follow the right course of action in a specific situation. It is not a rule-based, or rule-following, understanding of ethics that Aristotle is proposing. Rather, *phronesis* denotes such potentially universal, yet everyday behavioral qualities and attributes as prudence, discernment, sensitivity, and tact, as well as an intuitive or “natural” sense of what is “the good,” that is, the proper goal of action to be taken for the benefit of oneself and for that of others at any given moment.^{36,37}

Gadamer was quite explicit regarding the significance of this dimension for his work: “my whole philosophy is nothing but *phronesis*,” he once noted in an interview.^{38(p54)} The work of Benner et al³⁹ explicating the growth of novice to expert nursing practice (*praxis*) illustrates the role of judgment and *phronesis* in understanding the DIKW framework.

One of Gadamerian hermeneutics’ recurring motifs is that modern scientific rationality and technology have systematically forgotten *phronesis* in favor of exclusive promotion of *techne*—that is, the idea of “applying skills” as the most efficient way to solve problems. In the 1970s and earlier, Gadamer expressed rather prescient concern regarding the impact of information overload on an “unprepared humanity,” as technology progresses ever onward without being guided by *phronesis*.⁴⁰

We showed in the preceding section an example from the literature in which measurement of an abstract concept, spirituality, illustrated the DIKW framework from the perspective of postpositivism. Christensen and Turner⁴¹ also conducted research regarding nurses’ provision of spiritual care, but from a Gadamerian hermeneutic perspective. They sought to understand spiritual care from the perspective of registered nurses in Denmark. They used audio taped, unstructured interviews that were then transcribed (the words and text are the data). Using established

qualitative techniques, they sought to uncover meaning—both from the words/text themselves and from the context surrounding the words/text (data with meaning is information). They then explicated their understanding of spiritual care as the themes derived from their analysis (knowledge) and talked about possible interpretations and application of their findings (wisdom).

DISCUSSION

Epistemology is a way of explaining and understanding how we know what we know.²¹ It influences, but is not the same as, research methods or selecting the type of data used in research. Popper remained agnostic as to whether quantitative or qualitative methods should be employed to test scientific hypotheses.⁴² Quantitative methods require or presuppose a scientifically proven (falsifiable) epistemology for the sake of reliability and accuracy, for example, to preserve the integrity of clinical patient data. Qualitative methods may include a hermeneutic approach, for example, to help lend a personal voice to life-world experiences within an otherwise highly technical and very specialized professional discipline. Quantitative and qualitative research approaches have specific methods, or techniques, to answer a specific research question. They are not in conflict but are ways to answer different questions.²¹ Although statistical approaches are common in postpositivist research, broad affinities exist between the hypothetico-deductive approach and the hermeneutic process of question and answer in dialogue. Reconciliation between quantitative and qualitative approaches therefore no longer appears quite as unthinkable as it once might have.⁴²

The DIKW framework can be examined from seemingly conflicting, but actually surprisingly commensurable and complementary epistemological foundations. Nurses are knowledge workers—they need fundamental knowledge to support practice and they constantly generate and consume knowl-

edge. Nursing is also a practice profession with knowledge and practice being inextricably intertwined.^{13,18} Knowledge or theory supports practice by describing meaningful relationships between information and concepts.⁴³ Thus, theory is a means of representing knowledge (defined relationships between meaningful information) and is used to describe or explain practice phenomena, to predict outcomes from decisions or action, or to prescribe a course of action.

The initial components of DIKW, the data, information and knowledge components can be considered a direct fit with nursing practice, nursing informatics, and information systems. Wisdom, on the contrary, is more elusive. In addition to being a knowledge and practice profession, nursing is an ethical activity, requiring judgment and decisions.³⁴ Wisdom within nursing is then a uniquely human state, calling upon human attributes such as values, beliefs, and one's moral and ethical perspectives.

Given that wisdom is supported by knowledge, different manifestations of wisdom may exist. Wisdom may be manifested in nursing through "professional expertise"⁴³ or "clinical judgment."¹⁸ It may also be manifested in caring and compassionate practices that support each patient's particular life-world and in the moral and ethical decisions nurses make every day.⁴⁴

The ANA's addition of the concept of wisdom as represented in the DIKW framework is supported by multiple philosophical perspectives.² We concur that wisdom is an important element of the DIKW framework and adds value to the roles of nursing informaticists and nursing science.

Some lingering philosophical questions are as follows: (1) Will computers and EHR fully embody the DIKW and display wisdom? and (2) Can the internal processes of nursing judgment (wisdom) be identified and then programmed? Current technology used within EHRs today neither computes nor displays wisdom. Computers can display data, information, and knowledge including abstract concepts. They can receive

data and information and process it against stored knowledge (such as rules) to produce decisions or recommendations. To date, computers do not display tacit knowledge and may never be able to fully embody wisdom. However, the attainment of wisdom can be supported by computer systems. A computer system can be programmed with information and knowledge to promote human learning, understanding, and personal growth, which, in turn, support the development of human-centered wisdom.⁷

Wisdom is an attribute of human beings. Thus, even though computers do not themselves possess wisdom, nurses who use computers can exhibit wisdom in their practices and can develop wisdom through the use of computer systems. Nursing informatics specialists support developing wisdom through sound management and communication of data, information, and knowledge. The appropriate and ethical application of knowledge and theory is understood as wisdom.²

The DIKW framework can support the translation between research and practice. Understanding how the concepts of the DIKW framework overlap and interact will assist clinical nurses in the critical evaluation and implementation of research.¹⁷

The DIKW framework facilitates the nurse's ability to represent ethical practices. As knowledge workers, nurses collect data and information and make decisions that affect individuals, families, and communities.² Wisdom is intertwined with the principles of doing things right. Wisdom and ethics are attributes of each other. In addition, wisdom and ethics share the characteristics of judgment, caring, and responsibility. "Clinical judgment requires moral agency, insight, skilled know-how, and narrative reasoning about patient transitions."^{18(p103)} Proficient nurses show clinical wisdom with ethical discernment by demonstrating the ability to think critically and to act and practice responsibly, by applying abstract thinking and knowing to implement specific acts of care within specific situations. Wisdom is about comprehensibility, understandability,

and the ethics of our doing.¹⁵ Nurses with wisdom are engaged and pay attention to the ethical challenges they face. They believe the principles of morality and acceptable conduct are important for all people.⁴⁵

Wisdom, supported by a postpositivistic perspective, often takes the form of clinical judgment, asking, "Is this body of scientific knowledge applicable for patient X at the current time?" From the Gadamerian hermeneutic perspective, wisdom takes the form of praxis—the day-to-day decisions made by nurses with experience levels ranging from novice to expert.¹⁸

Nursing is a holistic practice, expanding beyond the physical dimension to include social, interpersonal, spiritual, and other dimensions. Like other professions, it is both an art and a science. The caring practices and discernment implicit in "nursing judgment" are often called the art of nursing. Many of the judgments nurses make can be identified and programmed into an EHR, but healing relationships cannot be reduced to objective data, nor can they always be predicted—nevertheless, we know they exist and recognize them when we experience them.¹⁶

CONCLUSION

Data, information, knowledge, and wisdom are foundational concepts for nursing and nursing informatics. We conclude that the DIKW framework provides a foundation for linking theory and practice. We presented 2 epistemological perspectives, postpositivism and Gadamerian hermeneutics that contribute foundational elements to nursing informatics and the DIKW framework. We discussed how both approaches conceptualize and clarify the aims of informatics, and described ways to study phenomena from both perspectives using the DIKW framework. The combination of postpositivism and Gadamerian hermeneutics provides an appropriate epistemological basis for understanding the DIKW framework. Awareness of the assumptions about knowledge in both approaches

will allow nurse informaticists, nurse scholars, and nurse researchers to link data, infor-

mation, knowledge, and wisdom in a meaningful way.

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