The Nursing Knowledge Pyramid
A Theory of the Structure of Nursing Knowledge

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A theory of the structure of nursing knowledge is proposed. Using retroductive reasoning to build upon an existing theory, the goal of the Nursing Knowledge Pyramid is to integrate disparate forms of nursing knowledge into a comprehensive, coherent, and useful structure to enhance the learning, development, automation, and accessibility of nursing knowledge. Education uses are discussed. Key words: machine knowledge, nursing knowledge, tacit knowledge, theory

NURSES must have the required knowledge, skills, and attitudes necessary to take actions that will achieve optimal patient outcomes. When it comes to the knowledge part of a nurse’s job, an important question is how the nursing knowledge base should be structured so that it is most useful to nurses in practice. Knowledge structures are important for nursing practice because they shape nursing behavior.1

However, nursing knowledge, like knowledge in other disciplines, is not a single repository of well-ordered knowledge,2 and long ago Donaldson and Crowley3 encouraged nurse authors to seek a means of explicating the nursing discipline’s body of knowledge. More than 30 years later, the problem was still challenging, as Kim1 concluded that having a unifying framework for epistemological discussions about nursing knowledge was critical. Addressing this need, in this article, we present an overview of a unifying theory of the structure of nursing knowledge, the Nursing Knowledge Pyramid (NKP) (Figure 1).

Science uses 3 kinds of reasoning: deduction, induction, and retroduction.4 Simply stated, deduction is top-down, general-to-specific reasoning; induction is bottom-up, specific-to-general reasoning; and retroduction is the improvement of existing theories.1 In the NKP, moving from bottom to top is deductive whereas moving from top to bottom is inductive. Retroductive reasoning improves existing theory wherever it is appropriate and is best illustrated in Figure 2.

As shown in Figure 2 (left), the current highest-level organizing structure of nursing knowledge may be the Structural Holarchy of Contemporary Nursing Knowledge (hereafter “holarchy”).5(p4) Fawcett called the holarchy a theory of the structure of nursing knowledge. It consists of a metaparadigm, philosophies, conceptual models, theories, and empirical indicators in a holarchy organized by decreasing levels of abstraction. Using retroductive reasoning, we build upon this theory to create an alternative theory—the NKP (Figure 2, right). We do so because we hypothesize that the NKP structure better supports the learning, development, automation, and accessibility...
**Statements of Significance**

**What is known to be true or assumed to be true about this topic:**
- Nursing knowledge structures shape nursing practice.
- The highest-level organizing structure for nursing knowledge may be the Structural Holarchy of Contemporary Nursing Knowledge, a theory consisting of a metaparadigm, philosophies, conceptual models, theories, and empirical indicators arranged in a holarchy organized by decreasing levels of abstraction.

**What this article adds:**
- Using retroductive reasoning, the proposed NKP builds upon the Structural Holarchy of Contemporary Nursing Knowledge to provide an alternative theory of the structure of nursing knowledge.
- The NKP theory may better support the learning, development, automation, and accessibility of nursing knowledge and therefore may better support nursing practice.
- As one exemplar, nurse educators and nursing students should consider using the NKP as a powerful cognitive tool for organizing the teaching and learning of nursing knowledge.

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The proposed NKP is truly exhaustive, the knowledge should map to some component(s) of the pyramid. Once the piece of knowledge is located on the pyramid, whether it is a new idea or an old one, the nurse then seeks to fill out each block of the pyramid to create a deep, rational, coherent, well-developed idea. This process leads to the learning of existing knowledge, the development of new knowledge, and the automation of all but intuitive knowledge. The details are provided later, however, think of the NKP as the building blocks of knowledge, from the most abstract to the most concrete.

To determine how to organize our discussion, we first need to decide which available theory template, which we call a **meta-theory** in this article, is appropriate. To leverage the integrity of the holarchy as much as possible, we adapted the Fawcett and DeSanto-Madeya analysis and evaluation nursing theory organizing framework as our meta-theory, as shown in the Table. Therefore, the NKP theory analysis overview (part 3) is analyzed according to its definition, scope, content, and context. External critics can then evaluate the theory according to the evaluation structure of the Table meta-theory (part 4).

**ANALYSIS**

**Definition of a theory**

A theory is “the creative and rigorous structuring of ideas that projects a tentative, purposeful, and systematic view of phenomenon.” Since Fawcett described her holarchy, upon which we build the NKP, as a theory of the structure of nursing knowledge, so shall we. It is a grand theory in scope and a descriptive theory in purpose. Overall, our purpose is to build a more useful structure of nursing knowledge.

**Theory scope**

Kim identified 4 levels of theory in decreasing levels of scope: grand, meso, middle-range, and micro. Grand theories further develop a particular aspect of a...
Conceptual model.\textsuperscript{5} A specific kind of conceptual model with a specific purpose is a discipline boundary metaparadigm (without the "-"), which places a boundary on the phenomenon of interest.\textsuperscript{5} Our selected nursing discipline boundary conceptual model, the Metaparadigm of Nursing, consists of the 4 concepts (the "nouns" bounding a discipline) of nursing, human beings, health, and environment.\textsuperscript{5} Because the NKP addresses the structure of knowledge required to enact optimal nursing actions, the NKP develops the concept of nursing. The NKP theory can, therefore, be classified as a grand theory.

**Theory context**

The phenomenon of interest is the structure of nursing knowledge at its most inclusive, most comprehensive level. It has relevance to what the profession knows and what a nurse knows. Epistemology is the branch of philosophy related to the nature and extent of human knowledge, that is, a system of justified true beliefs.\textsuperscript{7} The guiding philosophy of the NKP is epistemological coherentism, which is a foundational theory that is based on justifications and implies that for a belief to be justified, the range of beliefs it is based on must cohere with one another.\textsuperscript{7} The selections for the abstraction levels of the NKP will visibly support each other if they are logically coherent.

**Theory content**

Our purpose is to propose a nursing knowledge framework that facilitates the learning, development, automation, and accessibility of nursing knowledge by retroductively enhancing the holarchy theory it is based on. As shown in Figure 2 (right), the NKP theory enhanced the holarchy theory through 6 innovations: (1) added the tacit knowledge
abstraction level; (2) surfaced the database abstraction-level idea from the narrative to the diagram; (3) reversed the level-of-abstraction direction; (4) added knowledge meta-types; (5) wrapped the abstraction levels in a pyramid metaphor; and (6) added knowledge groups. As Wallis reminds us: “The creation of each theory requires a tradeoff between simplicity, generality, and accuracy.”2(p82) Although the NKP diagram is more complex than the holarchy diagram, our goal in the NKP diagram is to hit a cognitive “sweet spot” by increasing its self-explanatory content without making it overly complex, which discourages comprehension.6 Readers will need to refer to Figure 2 (right), as the following sections briefly describe the major concepts of the NKP and the rationales for these changes to the holarchy.

**Abstraction levels**

**Tacit knowledge**

The discipline of nursing is concerned with what the nurse knows but has not been made explicit. Tacit knowledge is the naturally occurring intuitive or prescient knowledge that is accessible to nurses but cannot be articulated. Intuition refers to the ability to quickly appraise the situation and act without conscious reasoning and has been proposed as an important explanatory concept that influences nursing practice.1 Prescient knowledge knows what is going to happen before it happens. For example, a nurse’s “gut feeling” may inform an intervention decision, but the nurse

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**Table. Example of a Meta-Theoretical Structure Outline**

| 1. Name (source): Framework for Analysis and Evaluation of Nursing Theories⁵(p311) |
| 2. Definition of meta-theory |
| 3. Analysis |
| Step 1: Theory scope |
| Step 2: Theory context |
| Step 3: Theory content |
| 4. Evaluation |
| Step 1: Significance |
| Step 2: Internal consistency |
| Step 3: Parsimony |
| Step 4: Testability |
| Step 5: Empirical adequacy |
| Step 6: Pragmatic adequacy |
may not be able to articulate the source of that feeling. Tacit knowledge is inherently disorganized. If it became consciously organized, it could be articulated and become explicit knowledge.

We believe tacit knowledge is important to any exhaustive typology of nursing knowledge. It is placed at the bottom of the pyramid because all knowledge is rooted in tacit knowledge. ⁸

Philosophies

Philosophies are the epistemological, ontological, aesthetic, logical, metaphysical, and ethical claims of a discipline. In other words, they are the broad perspective for practice, research, and scholarship ⁹ and the foundation for any theory development. ¹⁰

Paradigms/conceptual models

The next level of the NKP reflects a philosophical stance ¹¹ and addresses the paradigms and conceptual models that provide alternative ways to view the subject matter of a discipline and the central concepts of a discipline. Fawcett and DeSanto-Madeya defined conceptual models as:

A set of relatively abstract and general concepts that address the phenomena of central interest to a discipline, the propositions that broadly describe those concepts, and the propositions that state relatively abstract and general relations between two or more of the concepts. ⁵(p13)

Theories

There are 4 kinds of types or purposes of theories: descriptive, explanatory, predictive, and prescriptive. ¹ Descriptive theories are the most basic of theories and describe the essence of the phenomenon under study: its concepts, properties, and dimensions. ¹² Here, the phenomenon is the structure of nursing knowledge and the theory was created through a critical evaluation of the holarchy—specifically examining its empirical and pragmatic adequacy—and finding opportunities for improvement. Addressing these inadequacies led to the NKP descriptive theory.

Empirical indicators

Empirical indicators are the second from the highest tier in the NKP and bring forth the lower abstraction levels into the real world. Empirical indicators measure concepts and are the basis for evidence-based practice. More specifically:

An empirical indicator is defined as a very concrete and specific real-world proxy for a middle-range theory concept—an actual instrument, experimental condition, or procedure that is used to observe or measure a middle-range theory concept. The information obtained from empirical indicators typically is called data. ⁵(p17)

Databases

The data in nursing knowledge can be found in databases—organized collections of data. This level recognizes the reality that the nursing knowledge base is distributed between humans and machines. In the NKP, the term “databases” are used as a general term to denote explicit or original nursing knowledge that resides on machines.

Fawcett and DeSanto-Madeya ⁵ mention “patient databases” and “computer information systems” as part of the holarchy empirical indicators abstraction-level narrative. This approach may be problematic because they group nonempirical indicator knowledge under the empirical indicator label. For example, while typical real-world empirical indicators (eg, a patient’s blood pressure readings over a week) can be stored in a database, other kinds of databases exist that do not contain empirical indicators. Would collections of nursing theories, nursing interventions, or nursing decision-making strategies be empirical indicators? We think not. And what would you call the data generated by an empirical study that is stored in a database table but has not yet been analyzed and interpreted? It is nursing knowledge, but it is not tacit human knowledge and is not yet explicit human knowledge. These are examples of a different kind of knowledge, which we call machine knowledge, discussed later.

Also, collections of data have their own emergent knowledge, distinct from individual
pieces of knowledge. For example, knowledge discovery techniques such as data mining and text mining can uncover hidden knowledge by looking for patterns and relationships within the data and text, thereby generating new knowledge. This knowledge-producing function of machine knowledge may be hidden behind the empirical indicators label in the holarchy, but it is not explicit.

Note that although not all explicit knowledge needs to be databased to be useful, doing so makes knowledge usable by powerful automated analytical tools and widely accessible to nursing stakeholders. For example, the scholarly nursing journal *Nurse Education Today* and many other journals encourage authors to enable readers to link to the actual data sets referenced in their articles.13

This level of the NKP is placed at the apex because the contents of the databases depend on the knowledge in the lower levels of abstraction, and is more specific than the lower levels. This type of knowledge will become more important as the field of nursing informatics grows and more nursing knowledge is databased and made more accessible.

**Knowledge meta-types**

Why does the NKP have a line down the middle? The substance at each level of abstraction is important and so is its form. Except for the inherently disorganized tacit knowledge level, the vertical line in the NKP diagram divides each abstraction level into 2 parts: (1) an overarching structure (the “meta-” on the left side, of which there can be more than 1 to select from [hence the “1 . . . n” subscript]); and (2) the substance in that structure (the examples on the right side, of which there can also be more than 1 to select from). The Table shows an outline of a “meta-” (left side) at the theories level, which is adapted from Fawcett and DeSanto-Madeya.5

To avoid confusion, note that at the level of paradigm/conceptual models, a “metaparadigm” is not the same as a “meta-paradigm.” We use the “meta-” prefix to indicate a structure and “meta” (without the “-”) to refer to a higher abstraction level within an example, such as the Metaparadigm of Nursing. Kim1 noted the importance of both metatheorizing and substantive theorizing to more richly develop nursing knowledge. Meta-types provide an ideal structure for discussing the examples, acting as a quality control, so they are located next to, and immediately accessible to, the examples in the NKP. They also provide the ability to compare, contrast, and evaluate examples systematically (eg, comparing 2 theories). Although Fawcett and DeSanto-Madeya5 extensively discuss model and theory frameworks in their book, they are only tangentially associated with the holarchy theory, which does not include frameworks. Because we believe these frameworks are valuable components of the nursing knowledge base, we have included them as an integral part of the NKP theory and brought them forward in the NKP diagram.

**Knowledge groups**

The NKP theory groups the vertical abstraction knowledge levels into tacit knowledge, explicit knowledge, and machine knowledge (Figure 3). As discussed previously, tacit knowledge is the naturally occurring, but inarticulate, intuitive, and prescient knowledge that is accessible to each nurse individually. Explicit knowledge is the declarative, procedural, conditional, and structural knowledge that is deliberately accessible to nurses that can be articulated. Machine knowledge is explicit or original knowledge that resides on machines such as computers.

There are at least 2 reasons for creating knowledge groups: (1) they provide cognitive scaffolding for learning the abstraction levels; and (2) they provide an entry into the pyramid for the discipline of knowledge development. To illustrate this, by adapting the SECI (socialization-externalization-combination-internalization) knowledge conversion model,14 Figure 3 shows how knowledge can be converted and developed.
Figure 3. The Nursing Knowledge Pyramid translated for knowledge development.

from one knowledge group to another using the strategy exemplars shown. For example, tacit knowledge can be converted to explicit knowledge by using externalization strategies such as interviews and questionnaires. Likewise, machine knowledge can be converted to explicit human knowledge through knowledge discovery techniques such as data mining and text mining.

**Pyramid metaphor**

Why use a metaphor? We recognized an opportunity to create a metaphor as a cognitive tool to enhance the teaching and learning of nursing knowledge. Educational research shows that students excel when the teacher’s teaching styles are congruent with their learning styles. The Kolb Learning Style Inventory classifies learners into 4 distinct styles: divergers, assimilators, convergers, and accommodators. Most first-year undergraduate nursing students, as measured by the Kolb Learning Style Inventory, have either a diverger or assimilator learning style. Divergers have a strong imagination, are aware of meanings and values, and have a good ability to generate ideas, whereas assimilators have a strong ability to create theoretical ideas and like to reason inductively. When a learner is a diverger or assimilator, presenting a metaphor (such as the NKP) to the learner is an effective instructional strategy that promotes learning. Furthermore, when the content to be learned is either declarative knowledge (eg, remembering the NKP levels or remembering the definition of a theory) or procedural knowledge (eg, remembering how to substruct a study, discussed later), then the instructional strategy of presenting a metaphor is again recommended to promote learning. This is not surprising because metaphors can convey declarative, procedural, and conditional kinds of knowledge, and a metaphor can have powerful effects on long-term recall.
metaphor structure helps a novice integrate new information into existing knowledge, it is a powerful instructional tool. Why use a pyramid metaphor? Chinn and Kramer write that “structural forms are powerful devices for shaping our perceptions” and can convey “meaning of a whole beyond the formative elements.” Specifically, the pyramid form can convey broad-to-specific and complex-to-simple properties. These are the emergent properties of the NKP. For example, one quality of a pyramid is that of having a firm foundation. Here, to follow the philosophy of epistemological coherentism mentioned earlier, each level “rests upon” and is explicitly linked to the underlying levels to create a strong, unified, logical, broad-to-narrow abstraction whole. That is also why the NKP reverses the abstraction levels of the holarchy—to reinforce the idea of building a solid, coherent foundation.

USING THE NURSING KNOWLEDGE PYRAMID

Chinn and Kramer assert that “an important theory is forward looking; usable in practice, education, and research; and valuable for creating a desired future.” The NKP can support nursing practice, education, and research in many ways. This section highlights 2 uses for nursing education.

A vehicle for relating theory to research

Theoretical substruction uses relationship diagrams to tie nursing theory to nursing practice by making the implicit assumptions of a research study explicit, such as connecting research questions to analysis. Substruction has been used to assess the logical consistency of theoretical structures, designs, and analyses; to examine research literature; to plan the research process; to facilitate grant writing; and to theoretically derive variables for study from abstract concepts. In the NKP (see Figure 1), conventional theoretical substruction occurs at the line between the theories and empirical indicators levels. However, if substruction was utilized for transitioning between all NKP abstraction levels, this proposed deep substruction process can be a vehicle for operationalizing the previously discussed philosophy of epistemological coherentism throughout the NKP. As we use the term in this article, deep substruction is nearly identical to Fawcett and DeSanto-Madeya’s C/T/E (concept-theory-empirical indicators) process, which is a system for translating nursing knowledge into research, education, and practice. Both processes attempt to explicitly show the logical transitions between the abstraction levels. However, deep substruction additionally uses the new abstraction levels, uses the new “metas,” and requires a concept map as minimal output.

For example, Figure 4 illustrates how deep substruction can be used to succinctly characterize and assess the coherence of the assumptions in a research study. In this case, a piloted study was completed where patients with cancer who self-reported distress were recommended psychosocial coping strategies. Starting at the bottom of the diagram and following the arrows upward
through each of the abstraction levels, the situation-driven psychosocial coping strategy recommendations in the Decker Cancer Coping Rulebase (top of the diagram) were generated initially as tacit knowledge (bottom of the diagram) accumulated from the first author’s 30 years of experience as an oncology nurse aligned with evidence-based practice. These rules were compiled in a book and constituted her prescriptive microtheory of cancer coping—the Decker Theory of Cancer Coping. To bridge the logical gap between the Decker Theory of Cancer Coping and her tacit knowledge, supporting philosophies and paradigms were then found in the nursing literature and concept-mapped where appropriate. To operationalize the Decker Theory of Cancer Coping, empirical indicators were found and used in the study as shown. To automate these prescriptions (databases level), the treatment recommendations in the book were combined with the self-report instrument values to generate a collection of “If-Then” rules and collected in a rulebase (a type of database). Specifically, the “Ifs” were the patient responses to the psychometrically sound Distress Thermometer and Problem List instrument and the “Thens” were the psychosocial coping strategy recommendations and local referrals based upon patient responses. This logic was then programmed into an automated tablet computer application that was the centerpiece of a distress management program. The tablet computer application received the instrument self-reported input from the patient, used expert system reasoning (a type of artificial intelligence designed to mimic the reasoning of an expert) based on the patient responses to determine the recommendations, and printed out reports to the provider and the patient. The distress management program was then piloted in a small oncology clinic. Data analysis suggested the program was feasible, safe, and significantly effective. The NKP concept map in Figure 4 helps the reader understand the study by explaining the assumptions of the study succinctly and enables the evaluation of their logical coherence. In addition to requiring familiarity with the nursing
knowledge base, as a learning strategy, creating high levels of structural knowledge through semantic networks such as concept maps enhances comprehension of content, domain-specific problem-solving, and retention of material.18

SUMMARY

How knowledge is structured is important to any discipline, and the NKP theory provides a unifying framework for nursing knowledge at the highest level of abstraction. Kim reminds us that “multiple theories are not only useful but also necessary.”1(p13) Using retroductive reasoning, we applied 6 innovations to an existing theory to develop a new theory. Nurses and nurse educators should consider using the NKP as a powerful cognitive tool to facilitate the learning, development, automation, and accessibility of nursing knowledge, thereby increasing the probability of nursing success.

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