Viewpoint Paper ■

What Is Primary Care Informatics?

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Abstract Primary care informatics is an emerging academic discipline that remains undefined. The unique nature of primary care necessitates the development of its own informatics discipline. A definition of primary care informatics is proposed, which encompasses the distinctive nature of primary care. The core concepts and theory that should underpin it are described. Primary care informatics is defined as a science and as a subset of health informatics. The proposed definition is intended to focus the development of a generalizable core theory for this informatics subspecialty.

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Primary care informatics is an emerging academic discipline that remains undefined. This report makes the case that primary care informatics should be defined as a science and as part of the health informatics family.

In the United Kingdom, primary care informatics already is an established specialty. It has its own journal[1] and specialist group.[2] Worldwide, major informatics associations and primary care organizations have working groups[4–7] devoted to primary care informatics, yet none define it.

Historically, individuals with enthusiasm for information technology have developed an interest in informatics in primary care. This pattern applies to all the informatics groups specializing in primary care in the United Kingdom:

- The Tayside Primary Care Informatics group has specialized in chronic disease management.[8]
- Sowerby center in the University of Newcastle has produced PRODIGY (a prescribing decision support tool for general practice).[9]
- Nottingham University PRIMIS (a data quality project).[10]
- Primary Care Informatics Group at St. George's NeLH-PC and PCDQ Program (the Primary Care National electronic Library[11] and Primary Care Data Quality, an educational program involving learning from your own clinical data).[12]

These groups provide examples of how the academic primary care informatics agenda has been advanced as an epiphenomenon to their main programs rather than as their core activity. Sullivan[13] warns that working only with information and communications technology (ICT) leaves an academic void: "There are great opportunities for researchers. . . to fill the vacuum left by informaticists who are too busy writing their next line of code." Musen and van Bemmel[14] echo this view. They suggest that a focus on the provision and use of computers and information technology can only serve to obscure any emerging core scientific theory for informatics. The proposed definition of primary care informatics sets out to make this emerging core scientific theory more prominent.

Defining Primary Care

The unique nature of primary care is the principal justification for its own informatics subspecialty. Traditional definitions of primary care focused on primary care as the first point of contact for patients: "The first-contact health service for a patient who is sick or injured is staffed by trained primary care professionals."[15]

However, the shortcomings of this type of definition have been recognized for some time:

> Descriptions based upon the nature of problems actually seen by practitioners, or those based upon the way in which patients come for care, do not adequately distinguish primary care from nonprimary care. Definitions of primary care have stressed its first-contact aspects, coordinating features, comprehensiveness, and longitudinality. While these phenomena are adequate as gross descriptors, the

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> inability to quantify them reduces their usefulness to planners and evaluators.[16]

Starfield defined primary care as the specialty that sees any patient with any combination of problems. In her later work she described primary care's characteristics as first-contact care, longitudinality, comprehensive services, and coordination.[17] This approach has stood the test of time, and its influence is seen in more recent definitions. The Medical Research Council of the United Kingdom defines primary care as "First contact, continuous, comprehensive and coordinated care provided to individuals and populations undifferentiated by age, gender, disease or organ system."[18]

A similar definition has been promoted by both the Institute of Medicine[19,20] and the American Academy of Family Physicians. They articulate the importance of primary care and family practice in the health system, emphasizing the importance of information, if not informatics, to underpin quality:

> Primary care is a function that benefits people and is essential to successful health care systems. . ..
>
> . . .Family practice is a demonstrably successful approach to implementing primary care. What comprises family practice and the rest of primary care is defined, not by a textbook or a technology, but by the needs and demands of people living their lives in the context of their families and communities. . ..
>
> . . .Best family practice and primary care depends on information management.[21]

A new European definition of general/family practice[22] has recently emerged. This definition identifies 11 characteristics, six core competencies, three areas of implementation, and an overall description as a "person-centered scientific discipline." This complex framework has been simplified (Table 1) into three core activities:

1. Heuristic decision making (based on intelligent rules of thumb), rather than deductive reasoning (take a full history, examine and investigate the patient), is used in a context in which patients often present with vague symptoms and unstructured problems.
2. The more holistic, biopsychosocial model is used ahead of the more straightforward biomedical one. There is often a long-term relationship between individuals, families, and their primary care providers.
3. Primary care has its own scientific body of knowledge whose application enhances practice delivered using a patient-centered consulting style.

These three key themes form an important part of the definition of primary care informatics proposed.

Definition of Primary Care Informatics as a Science

There currently are no definitions of primary care informatics in the major bibliographic databases. A new definition can be framed in a number of ways. Staggers and Thompson[23] have proposed that there are three types of definitions of informatics: (1) technology-oriented definitions; (2) role-oriented, defining the role of informatics and the informatician; and (3) concept-oriented, which defines the conceptual framework of the discipline.

A concept-oriented definition allows the characterization of primary care informatics as a science, whereas technology- and role-oriented definitions have significant shortcomings.

Table 1 ■ Mapping from the 11 Characteristics and Six Core Competencies, Defined for Primary Care, to Three Areas of Activity

WONCA* Europe Definitions		Mapping of the WONCA Europe Definitions to Three Areas of Activity
Characteristics	Core Competency	
First contact for: 1. All health problems 2. Any person/age/race	Primary care management	1. • Heuristic decision making • Any patient
Efficient, + coordinating of primary and secondary care resources		• Any health need(s) • Patients often present with vague symptoms and unstructured problems
Undifferentiated problem, but may need early intervention	Comprehensive approach†	
Simultaneous acute and chronic	Specific problem-solving skills	
Specific decision-making process		2.
Physical, social, psychological, cultural and existential dimensions of problems	Holistic modeling	• Holistic • Biopsychosocial model
Person-centered Longitudinal with time	Person-centered	• Long-term relationship between individuals, families, and their primary care providers
Unique consultation process Relationship over time		3. • Patient-centered consulting
Promotes health Responsibility for community health	Comprehensive approach† Community-oriented	• Scientific approach to health promotion and primary medical care

*WONCA = World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians (World Organization of Family Doctors).
†Term repeated.

The Primary Care Informatics Working Group of the American Medical Informatics Association[24] has produced a technology-oriented vision statement:

> In order to provide all U.S. citizens with high quality, affordable healthcare, every primary care provider must be given the opportunity of using an electronic ambulatory information system, including a fully functional electronic medical record and the ability to access needed clinical information at the time and place of care.

If this were taken as a definition of primary care informatics, it would lock the primary care informatician into the delivery of technology.

Lorenzi[25] offers a role-oriented definition for medical informatics. This proposes four cornerstones: (1) producing structures to represent data and knowledge so that complex relationships may be visualized, i.e., modeling; (2) developing methods for acquisition and presentation of data so that overload can be avoided; (3) managing change among people, process, and information technology so that the use of information is optimized; and (4) integrating information from diverse sources to provide more than the sum of the parts and integrating information into work processes so that it can be acted on when it can have the largest effect.

Working within a role-oriented framework is less restricting that the technology-oriented example, but does not make scientific method a prerequisite. Van Bemmel and Musen[26] have created a conceptually oriented definition that characterizes informatics as a science:

- Informatics: "The science that studies the use and processing of data, information and knowledge"
- Medical informatics: "Informatics applied to medicine, healthcare and public health."

The attraction of a scientific definition is it that it predicates an experimental approach and the construction of hypotheses that can be challenged and defended. Primary care informatics is defined in three sentences as a science, oriented toward the special needs of primary care:

> The scientific study of data, information and knowledge, and how they can be modeled, processed or harnessed to promote health and develop patient-centered primary medical care.
>
> Its methods reflect the biopsychosocial model of primary healthcare and the longitudinal relationships between patients and professionals.
>
> Its context is one in which patients present with unstructured problems to specially trained primary care professionals who adopt a heuristic approach to decision making within the consultation.

Core Concepts and Theory of Primary Care Informatics

The emerging core concepts and theory within which a primary care informatician can conduct his or her experimental work is set out in four sections that follow.

An Epistemology and Ontology for Primary Care

An academic field should be able to point toward its own knowledge base, which has its own epistemology (theory) and ontology (description of concepts and their relationships). Although primary care has an expanding knowledge base, there is as yet no established consensus about its epistemology and ontology.

An Epistemology of Knowledge for Primary Care

Evidence-based medicine provides the cornerstone of the primary care knowledge base[27] yet does not provide a framework that includes all of primary care's knowledge needs. Polyani[28] and later Takeuchi and Nonaka,[29] divided knowledge into two types: *explicit knowledge* that can be codified and written down, and *tacit knowledge*, the internalized knowledge. The evidence base provides the core explicit knowledge base, but as yet there is no properly developed framework for valuing tacit knowledge in primary care.[30] There are, to date, only pointers toward the limitations of evidence-based medicine as an all-encompassing theory of knowledge:

- Clinical judgment has become devalued, and even the aficionados of the evidence-based approach are beginning to recognize this.[31]
- Tension is created when the primary care clinician, concerned about the need to implement the evidence, feels uneasy when this is not part of that patient's agenda.[32]
- The experience of the primary care professional and his or her relationship with their patient are important factors as to whether evidence is implemented.[33]

Knowledge management models for clinical practice are starting to address the need to value tacit knowledge alongside explicit,[34] but as yet there is no clear consensus.

An Ontology for Primary Care

The ontology of primary care is starting to be defined through its coding and classification systems. Traditionally, these were simple hierarchical structures; more recently they have become more complex, allowing concepts to be expressed. SNOMED CT (Systematized Nomenclature of Medicine–Clinical Terms) and ICPC-2 (International Classification for Primary Care) are the two systems destined to become the predominant classifications in use worldwide.[35] However, they still fall short of allowing the comprehensive mapping required to support patient centered care: "Terminology to support 'patient-centred' information systems... is of vastly greater scale than...the Clinical Terms (read codes)... and even SNOMED."[36]

Heuristic Instead of Deductive Reasoning as the Decision-making Process in Primary Care

Therapeutic decisions in primary care are usually made on a heuristic basis (intelligent rules of thumb).[37] The "rules" reflect the health beliefs and experience of that practitioner; the nature of a problem may be elucidated over

Table 2 ■ Contrasting the Decision-making Process in General Practice and Hospital*

Issue	General/Family Practice	Hospital
Problem type	Unselected	Selected
Who makes decisions	Alone, in isolation	Often made with other doctors and colleagues
Influence of knowledge of the family	Decisions affected	Decisions often made with no knowledge of the family
Time available	Short consultations, little time	More time to take history and fully examine
Seriousness and urgency of problem	Decision made by general practitioner outside hospital	Decided on before admission or referral
Type of problem	Worried about something, minor illness, chronic disease	Mainly major illness, chronic disease
Stage in natural history the disease is seen	Often early	Usually late
Type and range of decisions	Very broad, with several problems presented at once	More limited, depending on specialty
Review of decisions	Easily reviewed	Hard to review after discharge

*Adapted with permission from Essex.[37]

several consultations. The contrast of the nature of a family practitioner and hospital decision making is illustrated in Table 2.

By way of contrast, the usual approach to medical problem solving is to use deductive reasoning. The theoretical approach to support this has been described by Musen,[38] who identifies two components:

1. **The domain ontology:** Defining the concepts and their interrelation within the area under study.
2. **The problem solving method.** This has to be defined in general terms. This might be an algorithm, a statistical approach, or one of many other methods, alone or in combination.

Success with this analytical approach has been found using software that detects drug interactions,[39] and its utility has been seen in primary care.[40]

Fugelli[42] challenges whether limitation to a single domain is appropriate for primary care: "Doctors in other parts of medicine are devoted to a particular organ or a technology. The practice according to what the Germans call *Das Schemata*. . . .

. . .*Das Schemata* is not workable within general practice."

More than 15 years ago, Suchman provided insight into why this view may be correct.[43] She concluded that human computer interfaces that propose set cognitive models (*das schemata*) are likely to fail for three reasons:

- The immediate context may predominate: if it is important to patients with heart failure to tell a clinician about their grandchildren and their worries, then this agenda will fill the consultation—not the decision support tool for heart failure.
- Guidelines and rules are only a tool around which individuals organize their own conduct, for example, patients may not take their medicine as prescribed.
- Common sense drawn from experience modulates what happens; a child may have symptoms suggestive of illness, but the physician's experience informs him or her that this person is well.

Studies showing how infrequently decision support tools are used in the management of chronic disease[44,45,64] lend support to Suchman's views.

Although it might be expected that simple heuristic "rules" can be modeled easily, in reality, they are complex, depending on a unique set of factors that come together within that particular consultation. Things are complicated further by the recognition that the doctor–patient relationship is in itself therapeutic.[46]

Primary care informatics should therefore examine complexity[47] and complex adaptive systems[48] as potential sources of insight into how to model the consultation. Chapman[49] describes the divide that needs to be bridged:

> IT experts are extremely good at linear, reductionist positivist thinking, and not so good at constructing social solutions and appreciating other perspectives. So there is an inherent mismatch between the mode of thinking required to develop robust social solutions and the thinking required to develop robust technical solutions.

Using the Biopsychosocial Rather than the Biomedical Model

Engel highlighted the shortcomings of the biomedical model[50]: "The dominant model of disease today is biomedical, and it leaves no room within its framework for the social, psychological, and behavioral dimensions of illness." Primary care clinicians adopt a more holistic approach than that of their secondary care colleagues. Looking at patients from the psychological and social perspectives can create a richer picture of that patient.[51] Modeling in primary care is complicated further by the longitudinal nature of information gathering, sometimes over more than one generation, and the need to form an overview of each patient and his or her medical history. Modeling is a core activity for informaticians.[52] It has long been recognized that medical knowledge has many more levels of abstraction compared with other domains.[53] Probably, primary care sits at the most extreme end of the spectrum, requiring the most complex modeling of all.

There are modeling disciplines that are relevant to this level of complexity.[54] In the study of biological systems, it has

long been recognized that the constituent parts of systems working together produce coherent collective phenomena, so-called emergent properties.[55] The challenge is how to model these emergent properties. Systems thinking has provided useful insights[56] at one level, but so far it has no track record of developing health informatics applications.

A further complication is that the classification and coding systems used in primary care often impose a biomedical framework on the consultation. The process of coding is not neutral; the primary care informatician must be sensitive to this and ensure that technology will be deployed in a way that preserves trust[57] as well as improving medical care.

The literature on modeling the primary care consultation appears to have been largely ignored by the informatics community. These models set out tasks that need to be completed and optimum approaches.[58–60] The primary care informatician needs to look to model the primary care consultation so that technology can be developed to support it, rather than requiring it to change to meet what technology can offer.[61] If it does not, then primary care informatics risks producing a more impoverished environment than the paper-based records that it sets out to replace.[62]

Patient-centered Rather than Disease-centered Consultations

A characteristic of primary care is that patients present with the problems that are important to them. Balint[46] started the movement toward patient-centered consulting in the 1950s. Byrne and Long[63] found that the most frequent reason patients leave their consultation disappointed is that their agenda was not addressed. This work was built on by Pendleton et al.,[58] who developed the idea that if a patient's own ideas and beliefs were not understood, then it would be unlikely that the patient could either understand the relevance of the advice given or cooperate with it. Neighbour[59] captured the nature of the general practice consultation in his often quoted misquote of Milton Erickson: "In general practice, the consultation is a journey, not a destination."

Conclusions

Primary care informatics is defined as a science and as a subspecialty within health informatics. The implication of this is that hypothesis generation and experimental work should be used to extend the core body of a generalizable theory. The special place for primary care informatics is necessitated by the unique nature of primary care. The primary care informatics agenda needs to develop the means to model the complexity and unpredictability of human interaction within the consultation. The principle aim of the primary care informatician should be outputs directed toward the delivery of more effective consultations.

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