

Documentation of Patient Problems and Strengths in Electronic Health Records

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Abstract

Background: A whole-person representation captures not only patient problems but also patient strengths. To better understand and inform practice of person-centered care and documentation using a whole-person representation, a critical review of literature was conducted of the current state of patient problems and strengths documentation in electronic health records.

Methods: The informatics model of Data, Information, Knowledge and Wisdom is employed to develop this critical review. Two scientific databases were used to conduct a systematic search: CINAHL and Ovid Medline with the following search terms: strength*, problem*, whole person, wellbeing or well-being, electronic health record*, personal health record*, EHR*, and PHR*. 602 articles were returned. All articles were screened through review of titles, abstracts, or full texts. 24 articles were selected for this review.

Results: Four themes have emerged from this critical review. They are individual or cross-institutional use of problem-oriented EHRs, extension of problem-based EHRs with other integration, patient-centered integration of the problem-oriented EHR build, and construction of a whole-person representation to include strengths in the EHR documentation. The vast majority of articles focus on problem-based diagnoses and practices. Early reports of strengths documentation were found using a standardized interface terminology and ontology, the Omaha System. Results of two studies demonstrated the feasibility of using the Omaha System for whole-person documentation to capture perception of both problems and strengths.

Conclusion: Clinical information in EHRs is typically structured by problem-based diagnoses; however, there is emerging documentation of formalized strengths attributes using the Omaha System, which may promote a holistic approach to clinical practice and documentation using a person-centered, strength-based ontology.

Keywords: Electronic health records; Patient problems; Clinical information; Hospitals

Introduction

Electronic Health Records (EHR) document a patient's health history and encounters in clinical care and are strategically sought after as a vehicle for effective health management and efficient health service delivery to individuals and populations alike. Professional, industrial, and governmental recommendations and policy mandates drive the focus on EHR attributes [1,2]. The U.S. Centers for Medicare and Medicaid Services has created criteria for EHRs to meet the Meaningful Use guidelines and incentives [2]. Certification of EHR systems with defined sets of requirements for functionalities and features is also available from professional and industrial organizations.

The commonly accepted clinical information ontology to describe a patient in EHRs is based on a problem-oriented system thinking and design following the pioneer work of Dr. Lawrence Weed in the field of medical informatics [3,4]. Dr. Weed [5] proposed a method of organizing the problem list as the center of medical records to create a system of patient care solutions. Since its conception in the late 1960s, the problem list has received both professional and governmental recommendations and policy mandates as a standard in patient care records [6-9]. The Institute of Medicine (IOM) recommends use of a

problem list for care providers. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires a summary list, which is interchangeable with a problem list, as an element of a complete medical record. One of the core measures in the Medicare & Medicaid EHR Incentive Program is to maintain an up-to-date problem list of current and active diagnoses.

As a result, contemporary EHRs incorporate the problem-list as the center to build problem-oriented information structure in EHRs. The American Health Information Management Association (AHIMA) defines the problem list as "a compilation of clinically relevant physical and diagnostic concerns, procedures, and psychosocial and cultural issues that may affect the health status and care of patients" [10]. Such a definition by AHIMA captures a comprehensive representation of a patient's physical, psychosocial, and cultural issues based on problems. Such a problem-driven framework supplies clinical narration with "pertinent negatives" and "obscuring the more clinically relevant details" [11].

To effectively, efficiently, and safely manage the health and illness of individuals and populations, a call to nursing in recent years to lead the change of healthcare transformation has been made from IOM [12]. A reemerging nursing care model in the healthcare landscape is incorporating a strength-based nursing approach that was once carried out in the nursing process of patient care into the opposite end of the problem-oriented medical practice. Leveraging the use of patient's

strengths dated back to the tradition of a holistic nursing diagnosis as documented in a nursing care planning process. A nursing diagnosis of a whole person is not merely problem-based but rather encompasses the “positive energy” of strengths under all problems [13]. The positive outcomes in patient care by finding and using a patient’s strengths were demonstrated in the example described in the Nursing Ground Rounds [14].

More contemporary studies also support leveraging the use of strengths in patient care. A study conducted by Rotegard et al. [15] recognizes cancer patients’ own strengths as a crucial factor to help them get through their illness and encourages nurses to place a greater focus on bringing forth and supporting patients’ personal strengths in their care. A qualitative study done by the same authors investigated nurses’ perceptions and experiences of patients’ strengths and potentials in oncology care, and their findings reveal three core dimensions of strengths [16]. They are cognitive, emotional, and physical strengths. The study results indicate that nurses want to better utilize patients’ strengths and need the clinical and organizational support for this type of care practice. Studies also suggest that patients want their strengths and inner resources to be utilized by care providers [15,17].

As contemporary healthcare consumers drive the paradigm shift of healthcare toward a whole-person, person-centered approach in patient care, getting and describing patient stories requires a full representation using a person-centered ontology including consumer health vocabulary and language with a focus on both problems and strengths. Unconventional ways are explored beyond conventional medical routines with further recognition of meanings embedded in patients’ situations through the practice of narrative medicine [18]. This proposed practice encourages not only a care provider’s expanded capacities to perceive but also the increased capacities to capture and represent what is perceived, so that what might remain out of awareness becomes available to enhance and enrich the patients’ experiences and their stories, symbolized by the metaphor of the activated cellular membrane for an effective clinician and patient contact.

The lack of clinical representation of patient values, health goals, and action plans in an EHR hinders health care providers from offering respectful, ongoing self-management support to patients [19]. Both strengths and vulnerabilities of individuals and populations need to be considered and made visible when taking a patient-centric approach in health care [20].

Patient-centered care involves all the coordinated systems that cover medical, behavioral and social domains. Similar efforts to improve the patient experience in quality improvement and cost maintenance and reduction by using integrated care strategies have also been demonstrated in health systems around the global setting [21].

Purpose

Effective health management of individuals and populations calls for a holistic, person-centered approach in clinical care and documentation. A whole-person representation captures not only patient problems but also patient strengths [22]. Strengths are an integral part of well-being that involves physical, mental, and social dimensions [23]. To better understand and inform practice of person-centered care using whole-person documentation, a critical review was conducted of the current state of patient problems and strengths documentation in EHRs.

Scope

As the contemporary healthcare trend shifts toward patient-driven care, patient-focused health journey is taking on the center stage of healthcare management and services that extend traditional health care delivery models with an increased level of information flow, customization, collaboration, patient choice and responsibility [24]. Their accounted experiences should be captured by a patient ontology and reflected in health information systems documented in EHRs. This critical review illustrates the representation of a patient ontology in EHRs using the Data, Information, Knowledge, and Wisdom (DIKW) framework originated from information and computer sciences and adopted by the international nursing informatics community [25]. The early version of this framework conveyed concepts of data, information, and knowledge as described by Graves and Corcoran [26]. This framework was further expanded to include wisdom by American Nurses Association, and theorized with philosophical underpinnings by Matney et al. [25,27].

DIKW starts with data and the four components in this framework “build upon each other” with increased complexity as it ascends upward from the data concept [25]. In a conceptual description, the relationships as depicted in this DIKW informatics model are as follows: data are used to name, collect, and organize; information is used to organize and interpret data; knowledge is used to interpret, integrate, and understand information; and wisdom is used to understand and apply knowledge to practice with compassion [25]. As denoted by this model, data are the basic building blocks of an information system. Information gives meanings based on data. Knowledge is then further integrated and synthesized using available information gathered through data. And finally wisdom is acquired by knowledge built upon information through data.

A whole-person representation that captures the complete patient health experience and story includes the full spectrum of health from problems to strengths. To develop and use a person-centered ontology to capture patient experiences and stories from reality needs a whole-person representation using data elements to capture both patient problems and strengths. Adequate data representation is necessary to derive meaningful information which can further be used to generate knowledge and offer wisdom of practice based on generated and discovered knowledge. This progressive and cycling process in EHRs records a patient health experience and narrates a patient health story. DIKW framework can be leveraged to structure and capture a patient-centered health experience and create a person-centered ontology to express and document this health story. The scope of this critical review is, therefore, to uncover patient problems and strengths documentation in EHRs in the context of DIKW framework for organizing and expressing a patient-centered ontology.

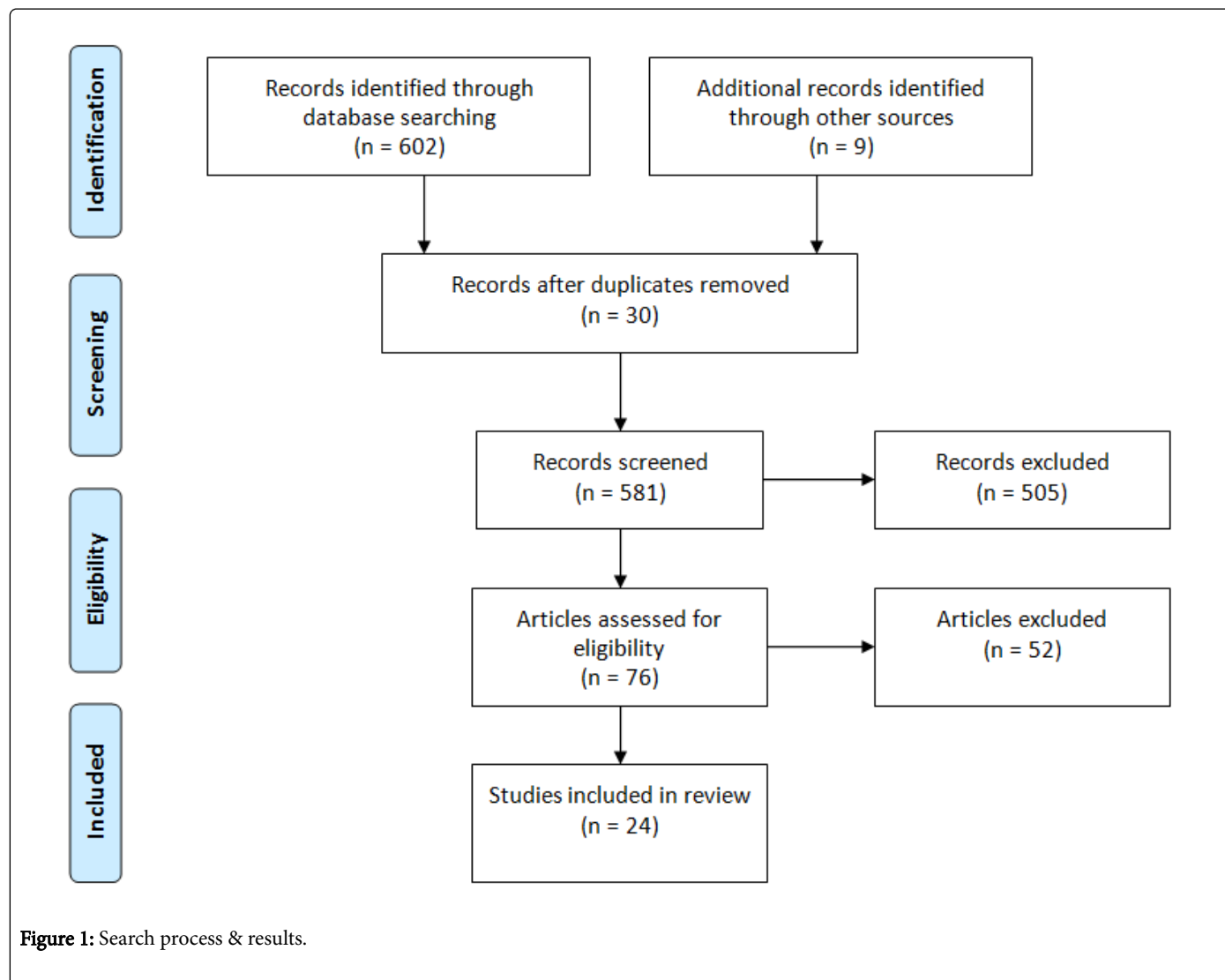
Search Strategies and Results

Two search strategies were employed to conduct this critical review search. One strategy was to perform literature search in scientific database and the other one was to review reference lists from selected articles to gather additional results. Two scientific databases were used to conduct this systematic search: CINAHL and Ovid Medline. Since the database PubMed overlaps with the database Ovid Medline in this academic setting where the systematic search was conducted, PubMed was used only for limited advance search. The following search terms were used: strength*, problem*, whole person, wellbeing or well-being, electronic health record*, personal health record*, EHR*, and PHR*.

Two search limits were applied: English language and year=2000 to current (March, 2016). 602 articles were returned with different combinations of designated search terms. Both inclusion and exclusion criteria were set for this literature search. The inclusion criteria were to include literature and studies if it was related to utilization and documentation of patient strengths and/or patient problems in EHRs and/or PHRs. The exclusion criteria were to exclude literature and

studies if it was written in a language other than English or published before 2000. All articles were screened through review of titles, abstracts, or full texts. Twenty-four articles were selected for this review.

The following diagram adapted from PRISMA 2009 Flow Diagram [28] depicts the search process and results in Figure 1:



Findings/Results

Time Period	# of Articles	Journals	Setting	Country of Origin
2000 to 2005	3	Peer-review journals; professional conference proceedings	Clinic; hospital; health system	U.S., Norway
2006 to 2010	7	Peer-review journals; professional conference proceedings	Clinic; hospital; health system	U.S., Belgium, Canada, Taiwan, Germany, Malaysia
2011 to March, 2016	14	Peer-review journals; professional conference proceedings	Clinic; hospital; health system; residential facility	U.S., Japan

Table 1: Selected article characteristics.

As described in Figure 1 above, twenty-four articles were selected for this critical review. The characteristics of selected articles are described in Table 1.

Four themes have emerged from this critical review. They are individual or cross-institutional use of problem-oriented EHRs, extension of problem-based EHRs with other integration, patient-centered integration of the problem-oriented EHR build, and construction of a whole-person representation to include strengths in the EHR documentation.

The vast majority of articles under this review reveal that clinical documentation is framed under a problem-oriented approach and

focus on problem-oriented clinical documentation in EHRs since the early years of EHR development and implementation during this review period. This problem-oriented EHR approach is also evident in the global setting. Under this broad representation, studies differ in the focus and scope around this medical/health informatics framework. There appears later on during this review period a contemporary trend that moves toward the extension of a problem-oriented EHR with the integration of a person-centric architecture and ontology into EHR systems. New meanings are also given to accompany the shifting trend toward person-centered care by introducing a strength-based model in the whole-person patient care and documentation. Table 2 below lists these themes and studies corresponding to these themes.

Reference #	Theme
[1,29-42]	Problem-based EHRs in an individual institution or cross-institutions
[43,44]	Extension of problem-based EHRs
[19,45,46]	Patient-centered integration of problem-based EHRs
[22,47-49]	Whole-person representation in EHRs with the inclusion of strengths documentation

Table 2: Themes and studies.

Problem-Based EHRs in an Individual Institution or across Institutions

Under this critical review, the majority of articles (15 articles) address computerized problem lists as the central foundation of electronic medical records (EMR) and EHRs in an individual institution or across institutions. These articles acknowledge problem lists as a key part of EHRs. Studies are carried out to explore different issues around problem-lists in a problem-oriented EHR system. Issues falling into the category of EHR systems in one institution or across institutions in this critical review include building a framework/model for problem-orientated patient records [29,30] developing EHRs based on a problem-oriented system [31], investigating representations of standardized terminologies for problem lists [1,32,33], designing methods to automate or generate patient-specific health problem lists [34-36], creating ways to improve the use of the problem list by healthcare teams to improve compliance to governmental policy mandates such as the Meaningful Use requirement for problem lists in EHRs [37,38], examining the use of problem lists within other clinical contexts [39,40], exploring clinician attitudes toward the use of electronic problem lists [41,42].

This review also suggests that standardized terminologies such as the Systematized Nomenclature of Medicine (SNOMED), the International Statistical Classification of Diseases and Related Health Problems (ICD) are used to capture the problem list and studies are conducted to evaluate and cross-compare standardized terminologies for their representation of problem lists and the associated implementation [1,32,33]. Studies are often performed to automate, generate, implement, improve, expand, and evaluate problem lists in EHR pertaining to clinical care qualities and outcomes [34-38]. The development of EHRs is closely associated with the health care policy-making and policy execution such as the Meaningful Use [37,38]. Problem-based EHRs have also been implemented nationally in the international setting such as in Norway, Belgium, Japan and Canada [29-31,35].

Bayegan & Nytro [29] proposed a two-layer framework for the construction of problem-orientated patient records to facilitate better patient care by mostly referring to record systems from Norwegian primary care patient record systems. This framework has a knowledge-based model to capture physicians' way of thinking and working, evaluate information use and needs and a relevance model to provide relevant support for content and usage in the system. The authors develop and merge three ontologies for this framework. They are process ontology for the primary care workflow, a patient record ontology for the rendition of the patient record content, and an information ontology connecting the process ontology and the patient record ontology. This framework supports better utilization of information in the patient record to support continuity of care, eliminate redundant and confusing information, and offer easy review of and better access to its content. However, this proposed framework has not been applied and tested, and so its applicability is not fully established. In addition, this framework is based on patient record systems in Norwegian primary care service, and so the generalized usability is in question in the EHR of a healthcare system in other setting.

De Clercq [30] measured the agreement between a problem-oriented conceptual model and the ways this model was implemented in 17 Belgian General Practitioners' (GPs) electronic patient records systems. This study used an original discriminating method to assess the implementation of the problem-oriented conceptual model. This model has six concepts including Health Care Element, Health Approach, Contact, Subcontact, Service, and Health Agent. Two evaluators evaluated each implementation and assigned the final result with a success or failure score within the scope of the official Belgian accreditation procedure for GPs' electronic patient records within almost all Belgian GPs' 17 software systems. The study results suggest that the problem-oriented conceptual model was successfully implemented within 65% of the software systems. The study concludes that a problem-oriented conceptual model can be successfully implemented and its quality can be assessed in many operational EHR

systems. The results also have an international implication in the improvement of semantic interoperability between patient information systems. However, since this problem-oriented conceptual model is specific to the Belgian general practice, it may not fully applicable in other health systems in different countries. The methodology used to evaluate the implementation may also require further examination for its appropriateness for EHR systems in other settings.

Steindel [1] conducted a comparison of approximately 5,000 terms in the July 2009 Clinical Observations Recording and Encoding (CORE) Problem List subset of SNOMED-Clinical Terms (SNOMED CT) to terms in ICD-10-Clinical Modification/Procedure Coding System (ICD-10-CM/PCS). Results showed that 6% of the CORE Problem List terms were not found in ICD-10-CM/PCS; 69.1% had equivalent ICD-10-CM/PCS terms; 13% of terms could be used with acceptable partial clinical precision; and 11.9% of terms required rule-based mapping. This study results suggest that ICD-10-CM/PCS meets the intended design goal of increased clinical precision but studies are needed to precisely define the depth of coverage. As the author states, site-specific clinical needs may determine the selection of a certain set of standardized terminology. This study offers certain general guidance, and yet its institution-specific guidance is lacking.

Wasserman & Wang [32] investigated the representation of the standardized terminology SNOMED CT for problem lists within a Computerized Physician Order Entry (CPOE) system in the EHR implemented at the 820-bed Cedars-Sinai Medical Center. The authors evaluated the breadth of SNOMED CT terms and concepts for the coding of diagnosis and problem lists by clinicians for each patient admitted into the hospital during a four-month period. The study results showed that the majority of diagnosis/problem list terms about 88.4% were found in SNOMED CT with 98.5% concept coverage after taking into considerations of other missing terms. This study suggests that SNOMED CT is a relatively complete standardized terminology that could be utilized as a vocabulary to construct the clinical problem list. As this study describes, the clinical representation of patient problems were derived from both structured and unstructured texts through a data extraction process. Hospital-specific terms and other terms not represented in SNOMED CT were also taken into considerations. This process indicates that a standardized terminology such as SNOMED CT is constantly evolving as well as problem lists that need to be represented by a standardized terminology. It demonstrates the need for a patient-centric problem list. However, this study does not discuss the integrity of collected data and thus it may affect the accuracy of terms evaluated for this coverage.

Fung and Xu [33] commented that SNOMED CT is becoming an internationally recognized health terminology standard for encoding clinical information in EHRs. They conducted a study to evaluate the coverage of its CORE Problem List Subset and its growth pattern using the eight problem list datasets from the CORE Project that covered about 18 million patients mostly in the U.S. institutions. They did a "leave-one-out" analysis of the eight current CORE Subset datasets to evaluate frequently used terms and the corresponding usage of the covered terms. A retrospective experiment was done to study the growth pattern and examined the relationship through linear regression between the size of the starting subset and the coverage of frequently used terms in the incoming dataset. The study results indicate that in the left-out dataset, the CORE Subset covered 80.3% of the frequently used terms with 83.7% term usage of the covered terms. A significant positive correlation was also demonstrated between the CORE Subset's size and the coverage of the frequently used terms in an

incoming dataset that implies a slower growth of the CORE Subset as it gets bigger. The study concludes that the CORE Problem List Subset is a useful resource for the SNOMED CT implementation in EHRs with good coverage of frequently used terms and a high proportion of term usage. However, this study may possess data selection bias. It considers only the most frequently used local terms with 95% term usage that can be mapped to SNOMED CT.

Wright et al. [34] developed 6-step, replicable, automatic methods and knowledge base for inferring patient problems targeted at 17 conditions by developing and validating a set of 17 rules using structured data based on both clinical and billing information such as medications, laboratory results, billing codes, and vital signs. This study was conducted by performing association rule mining on coded EHR data from a sample of 100,000 patient records at the Brigham and Women's Hospital in Boston, Massachusetts. Results validation using 100,000 randomly selected patient records indicated a better overall performance using the inference rules than using either the problem list or billing data alone. These rules can be applied to clinical decision support, care improvement, augmentation of the problem list, and patient identification for cohort research. However, this study also poses certain limitations in data selection for problems. The problems are based on a gold standard that selects problems documented in clinical data which may imply some misclassifications and thus it would influence the analysis results. In addition, some problems also have a selection bias according to association strength between labs and medications.

Poissant et al. [35] suggest that health problem lists are a key component of EHRs and are useful for best clinical practices and optimal patient safety. They conducted a study to assess the accuracy of a novel approach to create an inter-institutional automated health problem list in an EHR generated from three integrated sources of information for ambulatory patients in the Canadian province of Quebec with 7.5 million residents who have access to a public health insurance program. These three sources were diagnostic codes from medical services claims, therapeutic indications from electronic prescriptions, and single-indication drugs. Data were collected from 121 general practitioners and medical services provided for 22,248 of their patients. Results suggest that automation of an inter-institutional problem list added over half of all validated problems to the health problem list and could provide timely access to accurate and relevant health problem information with accelerated uptake and use in the EHR. This study is performed in a national health system in Canada, and so its generalizability to other settings remains a question.

Wang et al. [36] mentioned that problem lists are essential to EHRs. The authors developed and implemented a problem list dictionary and search algorithm, and they also evaluated its use in several EHR systems by assessing overall coding rates of a sample of 10,000 problem entries from each system at an integrated delivery network, Partners HealthCare System in Boston. Results suggest that the overall coding rate varied significantly between different EHR implementations between 63% and 79%. Three most frequent reasons for uncoded entries were related to user interface failures which accounted for 44% to 45%, insufficient dictionary coverage from 20% to 32%, and non-problem entries between 10% and 12%. When entries were coded, they were always appropriate at 99%. This study suggests that the problem list dictionary and search algorithm demonstrates a good coding rate, but the specific user interface implementation influences the variation in problem coding rates. On the other hand, this study was carried out in an integrated health delivery network, so the lack of consistent

coding by clinicians using different EMRs may affect data collection and thus results.

Bakel et al. [37] pointed out that the problem list in EHRs is a considered incentive criterion for the Meaningful Use and these authors conducted a quasi-experimental, time series quality improvement study to investigate the use of a series of interventions on the outcome of 80% of medical and psychiatric inpatients with a problem added to the problem list before discharge in the Children's Hospital Colorado. The study results suggest that significant increases happened with inpatient problem list usage by both medical and psychiatric teams after initiation of these series of interventions in this study and the outcomes met the quality improvement goal designated by the Meaningful Use for greater than 80% of inpatients to have a problem list at discharge. This study also encounters some limitations. A data selection bias is shown due to lack of accuracy verification about the problem list. The intervention is conducted at one site and so its generalizability to other locations is not fully established.

Pacheco et al. [38] originally developed and validated an algorithm to identify type 2 diabetes cases in the EHR to support clinical research and it was reapplied to identify problem list gaps by examining the problem lists the algorithm identified and determining the absence or presence of a structured code for diabetes within the Northwestern Medicine Enterprise Data Warehouse from 36 source systems. The study findings suggest that a corresponding structured code was present in the problem list for over half of patients identified by the algorithm, which failed to meet the threshold of Meaningful Use guidelines for a patient's problem list. The authors conclude that the application of such algorithms in EHR could fill gaps in the problem list omissions and help meet Meaningful Use requirements. However, since this study was done by using an Enterprise Data Warehouse, the generalizability of the study findings is limited beyond this setting. A significant proportion of data used from this Enterprise Data Warehouse is captured as structured elements, and hence the processing of unstructured data elements needs to be considered for the application of such algorithms in this study to other settings.

Banerjee et al. [39] carried out a two-step study to evaluate how often obesity presented on the problem list and whether the addition of obesity to the problem list would affect the frequency for it to be addressed in a patient's future visits at an urban family medicine residency office. After the first step of assessment to determine how often obesity appeared on the problem list, a randomized controlled trial of patient records was pursued after the intervention of adding obesity to the problem list to evaluate whether this intervention would affect the rate of addressing obesity in a patient's future visits. The results show a significant relationship between the addition of obesity to the problem list and addressing obesity at future visits by providers. The study implies that this intervention has the potential to change provider behavior with the automatic assistance in EMR. However, this study is performed at one site and it can limit the generalizability of its findings. The study also uses the encounter form diagnosis as an indication for addressing obesity and it lacks a specific description as to how the issue is addressed by provider.

Van Vleck et al. [40] indicated that the generation of a patient history summary in the EHR was commonly created based on the patient problem list. In their study, the authors studied the use of problem lists within other clinical context by analyzing the structure and content of the Past Medical History (PMH) sections in a collection of 7,673 initial visit notes obtained from the Columbia University Medical Center Milstein Hospitalist Service for inpatient admissions of

all types from late 2006 through early 2007. Their study results demonstrate that physicians tended to describe several semantic types of information in addition to problems when documenting patients' history. Related concepts were also grouped in a single line in the PMH. On the other hand, traditional problem lists were captured by a simple list of coded terms. Content analysis reaffirmed the value of more complex representations with valuable data and guidelines for automated generation of a clinical summary. However, the data source in this study comes from the initial visit notes upon admission from a hospitalist service, and so there is a lack of differentiation by diagnosis and specialty for a more complex representation of clinical summary generation.

Wright et al. [41] did an ethnographic study of healthcare providers' attitudes towards the problem list using grounded theory methods from April 2009 to January 2010 among academic and community outpatient medical practices in the Greater Boston area. The study results indicate that healthcare providers' attitudes towards the problem list varied and were categorized into nine themes. These nine themes were workflow, ownership and responsibility, relevance, uses, content, presentation, accuracy, alternatives, support/education with one cross-cutting theme of culture. This study concludes that there were significant variations of clinician attitudes towards and use of the electronic patient problem list, which requires clearer guidance and best practices for problem list utilization. However, this study is also done in one health system, and so the transferability of its findings to other settings is limited.

Holmes et al. [42] conducted an observational cross-sectional qualitative study to explore hospital practitioner opinions towards the problem list and the logic that drives their decisions in their clinical situations at two major Boston teaching hospitals. Data were collected through in-person interviews and an online questionnaire. Vignettes of clinical scenarios were used to frame questions about practitioners' preferred actions towards the problem list. Data analysis results agree with prior research that practitioners demonstrated different opinions about the problem list management, but this study results also indicate a common approach among the majority of practitioners. In addition, basic demographic characteristics of providers did not strongly affect their attitudes towards the problem list. The results also indicate that defined problem list policies and EHR tools are needed to formulate a common approach to guide the creation of accurate problem lists over time. This study also shows some limitations with the sample selection. The sample is convenient and limited to practitioners at two affiliated, academic medical centers, and so the sample lacks representativeness to produce generalizable results.

Problem oriented EHR systems are adopted and implemented internationally. Uto et al. [31] described that problem-oriented EHR systems are recommended in the clinical guideline in Japan. In their article, the authors described a system function that allowed all professionals to document and share the patients' clinical information including patient problems chronologically as an identical record in a hospital information system. This system function is implemented in an EHR system in Japan and its applicability is limited to the settings in other locations.

Extension of Problem-Based EHRs

Two articles under this review discuss the expansion of a problem-based EHR system by integrating other area of care activity. Englebright et al. [43] described incorporating basic nursing care for hospitalized adult patients through the implementation of a 170-bed

community hospital EHR located in the central US. The results of this effort integrate the use of a standardized terminology, the Clinical Care Classification (CCC), into the hospital EHR to capture 9 basic nursing care activities with 1 additional basic nursing care activity identified following the pilot implementation in the EHR. The results of this project show how to define the concept of basic nursing care and distinguish it from the interdisciplinary, problem-focused plan of care. This project also indicates that the use of EHR can facilitate communication and documentation of basic nursing care elements and improve nursing process. However, this project attempts to define basic nursing care for adult patients in a hospital setting, and so the definition was limited to the adult population in this setting. Moreover, the testing of this project was conducted in an EHR at a single hospital, and thus the generalizability of its results is also limited.

Rosenberg [44] described in her article the adoption and implementation of Jean Watson's Theory of Caring in the EHR for clinical nursing staff to document the patient experience using a language specific to nurse caring relations and its many meanings in a Chicago-based eight-hospital healthcare system. The development of this new nursing clinical context in documentation occurred during an extensive clinical documentation system upgrade in the EHR. During this project, available standardized nursing terminologies including NANDA, NIC and NOC were reviewed. When a documentation terminology does not exist within the current taxonomies to document the patient experience that incorporates the context of an applied theory in nursing care, the author encourages nurse leaders to take an active role in developing new terminology when needed to capture the expression of the patient experience. The development of this system-wide documentation terminology for nurses to capture the patient experience using a theoretical framework is institution-specific, and so its generalizability and relevance to other institutions needs to be reevaluated for their own settings.

Patient-Centered Integration of EHRs

Three articles in this review consider patient-centered integration of an EHR system. Almunawar et al. [45] recognize the need to include patients as partners in care. They propose a novel, holistic representation of health data by reorganizing and extending EMRs with Web 2.0 features for a patient health record with the additional incorporation of personal and social dimensions. They name this new representation Electronic Health Object (EHO) to increase patient interactivity in health care systems. The EHO includes three objects. They are medical objects, social objects, and personal objects that work together to facilitate interactivity. Individually, social objects build clinic social networks for patients to share their health experiences; personal objects create a personal space to strengthen patients in generating personal health habits; and medical objects allow patients to view their medical records. This framework addresses the emerging need for interactivity among patients and providers by preserving and extending existing EHR data and empowers patients to be active partners of health care services in health care processes. This article describes implementing EHO with Clinic 2.0. However, no specific discussion is made about testing and its related results. So the applicability of this model is still at a conceptualized stage. This platform also raises privacy and security concern related to sensitive personal and health information.

Li et al. [46] suggest that a more patient-centered approach to EHR is emerging around the globe accompanied by increased patient access and personal use of EHRs. This trend makes patient empowerment an

important issue of EHRs. In this study, the authors synthesized comprehensive, empirically-based conceptual models of EHR for personal use by reviewing prior papers or case-studies for EHR systems used or designed for nation-wide use. They identified 3 models, including the inexpensive data media model, the internet patient portal model, and the personal portable device model with their own recognized strengths and weaknesses. They also synthesized a new behavior of personal use of EHRs, which is referred as Business (Provider) to Customer (Patient) and Customer (Patient) to another Business (Provider) with last process as optional (B2C(2B)). This model allows patients to access their provider EHR and to share it with another provider if they choose. The authors believe this model looks promising according to their study. Since this study reviews papers designed for nation-wide use, it may limit its generalizability of its findings to other different settings.

A drive to patient-centered care has also emerged in other areas of EHRs. Chunchu et al. [19] conducted a one-year, experimental, prospective cohort study to evaluate an EHR-based Patient Centered Care Plan (PCCP) in improving collaborative self-management planning in a family medicine residency clinic. Results suggest that PCCP facilitates patient engagement in support of chronic illnesses self-management in goal setting and action planning. The authors state that "EHR design that stores patient values, health goals, and action plans may strengthen continuity and quality of care between patients and primary care team members" (p.199). However, this study encounters several challenges that reduced the sample size and hindered a robust assessment of the patient experience, and thus it may affect the full optimization of PCCP and study findings.

Whole-Person Representation Including Strengths

Four studies in this review explore the inclusion of strengths in nursing care documentation. In their study, Monsen et al. [22] looked at the feasibility of using a standardized terminology, the Omaha System, for documenting wellbeing in EHRs using strengths indicators and signs/symptoms data from 5 seniors living facilities in a residential community. Using concept mapping techniques, this study mapped the Omaha System to the Wellbeing Model constructed for nursing documentation in a strength-based wellbeing assessment located in the EHR. The feasibility was also assessed of using the Omaha System to describe strengths and needs of the senior population based on this assessment. The study results suggest that problem concepts with more signs/symptoms had fewer strengths and the ratio of strengths indicators to signs/symptoms was 6:1 with a range between 2.8 and 9.6. This study concludes that the Wellbeing Model and the Omaha System have potential to capture a whole-person perspective to document strengths and wellbeing for a senior population in community. However, this study also described the challenge of accessing the wellbeing data in the EHR during the software development for this study and it may exert some impact on the study results.

Another retrospective secondary analysis study done by Monsen et al. [47] examined the feasibility of using the Omaha System to classify strengths of older adults with chronic illness by mapping 421 codified strengths phrases to the Omaha System concepts from existing narratives of 32 older adults with 12 to 15 comorbid conditions. Exploratory analyses in this study demonstrated unique strengths profiles for 30 of 32 patients and showed the feasibility of using the Omaha System to describe strengths of patients with chronic illness. The study concludes that there is a potential to capture the perception of both problems and strengths by using the Omaha System as a

whole-person assessment tool for nursing care and documentation. However, this explorative analysis is based on a limited sample dataset to detect patterns in strengths data, and therefore the representativeness and generalizability of the findings is limited.

Rotegaard & Ruland [48,49] conducted two studies to explore the representation of patients' strengths and perspectives which they developed for a health assets conceptual model in a standardized nursing vocabulary, the International Classification of Nursing Practice (ICNP). They cross-mapped the core concepts of this health assets conceptual model that has a focus of care for wellness outcomes to ICNP Version 1.0/1.1 in their first study and the concepts of this health assets conceptual model to ICNP Version 2.0 in their second study.

Their first study found that most of the health asset terms in the conceptual model were captured in ICNP on a global level. However, a complete set of health asset terms is needed in ICNP to provide optimal support of nursing care and patient self-care [48]. The second study found that ICNP captured 33 of 76 health assets concepts/terms with several other health assets categories and subcategories embedded in the descriptors of other ICNP concepts/terms [49]. The study also detected a lack of a number of positive statements in some ICNP terms to represent the health assets approach and a patient's strength perspective. The authors conclude that the inclusion of additional health assets concepts in ICNP would reflect and support patient-centered nursing care. However, the proposed health assets model is a conceptual model that needs to be tested in practice and mappings to ICNP need to be further validated.

Discussion

As indicated in the findings, from the early stage on during the time period of this review, the majority of studies demonstrate that the four components of data, information, knowledge, and wisdom depicted in the DIKW informatics model are structured on a problem-oriented basis to document a patient health encounter. Data used for naming and organizing to further build information for a patient health story appear to unfold around patient problems. Likewise, knowledge developed from interpretation, integration, and understanding of information as well as wisdom used to understand and apply knowledge to practice with compassion by providers follow the same problem-based encounters and events, which ultimately are employed to construct a problem-focused plot and resolution with providers as the persona of narration in this patient health story.

Under this problem-based representation of a patient health experience, these articles reveal a few recurring topics in literature around problem lists in EHRs. Problem lists as the central component of modern EHRs are finding various ways in their standardized representation, automation, generation, implementation, improvement, and evaluation to support continued sequences of care and better patient care solutions in a patient health journey [1,32-36]. In the EHRs, standardized terminologies such as SNOMED and ICD are used as structured vocabulary to describe a patient's problems [1,32,33]. Mappings to such standardized problem vocabulary are studied to facilitate automated interpretation of problem data, information exchange among providers and administrative sources. These various ways demonstrate that problem-oriented records are aimed to enable better knowledge management, and so methods and strategies in research are utilized to move in that direction.

However, even though a problem list should cover any concept from a comprehensive spectrum of issues as recommended by AHIMA [10],

the studies from this review suggest a medical and clinical representation of a patient's problems as captured by the standardized terminologies in SNOMED and ICD [1,32,33]. Within this scope, it appears that there is no universal representation of diverse problem lists. The development and implementation of problem lists are carried out by individual institutions or cross-institutions. Problem-lists are enterprise-specific in US, which agrees with what is reported in literature that the content and utilization of the problem list vary from institutions and providers [1,50]. Therefore, at the data level, no consistency is established, and consequently, diverse information is documented in the EHR and knowledge management is operationalized based on an enterprise-selection of problem list sets. Even though efforts are pursued to move beyond a singular representation pertaining to an enterprise and rules are developed purposefully to generate to a more universal setting as reported in the studies under this review [30,32-35], work in this area appears to be disjointed and lack of coordination as suggested in literature [4].

In addition, using terminologies with partial or inadequate coverage as suggested in several studies [32-38] limits a complete representation of data and information pertaining to the expression of a patient's health encounter. The inconsistency across enterprises and a lack of a full data representation in an individual institution or across institutions around the problem list point toward inadequate knowledge database and management with regard to a full description of a patient health experience. As a result, structuring EHRs around a problem list poses its own problems and efforts are sought to expand beyond a problem list as what is revealed in the later period of this review.

Toward the middle part of the time period covered in this review, two articles suggest an expansion of data naming and organizing beyond a problem-based representation by incorporating other areas of care into a problem-based HER [43,44]. Both articles describe the extension of a problem-oriented EHR with added contents and functions to communicate and document nursing care elements by creating a system-wide documentation terminology to record and express their patient experiences. These projects expand the knowledge database for the documentation of a patient encounter in supplement of a problem-based EHR. As a result, the patient story has evolved to include more perspectives as more providers become narrators of a patient story.

During the latter time period of this review, three articles demonstrate a patient-centered, patient-specific integration to name and organize concepts into a problem-oriented EHR system [19,45,46]. This trend occurs to merge all the themes around patient-centered care management and delivery around EHRs. These articles examine a holistic representation of a patient health experience and encourage a patient to be the persona of their health story through patient empowerment, engagement, and partnership with providers to record their own health occurrence.

During and close to the same latter timeframe under this review, four articles recount a new emerging wave of migration from a problem-based EHR system to a whole-person representation of problems and strengths in EHR documentation [22,47-49]. Early reports of strengths documentation were found using two standardized interface terminologies, the Omaha System, and ICNP. Results of two studies demonstrate the feasibility of using the Omaha System for whole-person documentation to capture perception of both problems and strengths based on a wellbeing model [22,47] while two other studies examine mappings of strength concepts from a health assets

model to the standardized terminology, ICNP [48,49] Findings illuminate the merits of a strength-based approach in chronic illness management and wellbeing.

Based on the final emerging trend generated from the themes of this review, there is a potential to achieve the person-centered goal by creating a person-centered ontology from an integrative perspective with the use of standardized terms to capture both needs-focused and strengths-based care and documentation. Formalized strengths attributes using a whole-person approach is a novel development in standardized terminologies [22,47] Utilizing a strength-based ontology may equip individuals with personalized strengths, potentially leading to better individual health management and population wellbeing. This patient-centered, strength-based ontology can build the four components of data, information, knowledge, and wisdom in the DIKW informatics model around a whole-person representation with a robust and improved knowledge management system that includes both problems and strengths for optimal patient care and outcomes. As Cimino [11] points out, "clinicians should recognize that current EHRs are illuminating the opportunities for the next generation of systems that will support clinicians as active partners across the spectrum of healthcare settings and tasks". The next generation of EHR systems looks promising for optimal care and documentation by using a patient-centered, strength-based ontology to support the expression of a patient health story of perpetual self-becoming constructed and narrated from a patient's persona of strengths.

Implications

This critical review of literature has implications for theoretical, research and ethical practice in nursing. Based on this review, clinical information in EHRs is typically structured by problem-based diagnoses; however, this emerging documentation of formalized strengths attributes captured by the Omaha System may promote a holistic approach to clinical practice and documentation using a person-centered, strength-based ontology. This strength-based model utilized to develop a person-centered, strength-based ontology offers an innovative approach to nursing care and this area of research has the potential to make significant theoretical and conceptual contributions to the discipline of nursing. Further nursing research in this area needs to be developed to test and evaluate this emerging patient care and documentation model so that new knowledge of patient care in nursing can be generated and the theoretic and conceptual roles this model plays can be validated in constructing and narrating a patient health story.

As mentioned before, limited research has been found using the Omaha System for whole-person documentation to capture perception of both problems and strengths based on a wellbeing model in the senior living community. No study has been performed to evaluate the effects of this strength-based model on patient wellbeing and patient outcomes. Further studies are warranted to better understand how a strength-based nursing care model could affect an individual's wellbeing, quality of life, and health management. Therefore, one potential area of study is to examine the patient wellbeing and health outcomes in the senior living setting using this strength-based nursing care model to provide illuminating results among strengths, problems, and health outcomes. Findings generated from this area of study could shed light for the results of a strength-based approach in patient care and health management.

When developing and implementing this research, the ethical principle of respect for an individual freedom and autonomy can be used to guide this research process. The ethical principle of respect for autonomy and individual freedom endows a patient the right to receive a full representation of a patient's complete health experience with the patient in the center of care. In the meantime, this ethical principle also supports a patient's right to make informed decision, voluntary participation and to withdraw from the study. Following the same ethical principle, another area to consider is to protect a patient's privacy, confidentiality, and security of the sensitive health information related to their care and documentation. In addition, the guiding ethical principle of beneficence also applies to this area of research. The research in this area could potentially offer a better health management and delivery solution with demonstration of a direct linkage to better individual health outcome and wellbeing. In return, the research results in this area could be used to help policymakers make informed decisions to benefit both individual and public health.

Using the DIKW informatics model to construct a person-centered, strength-based ontology to capture and document a whole-person health story includes the recordings of health, illness, strengths and problems with a healthy theme leading toward a meaningful and fulfilling ending. To build such a person-centered, strength-based ontology in EHRs requires the integration of both medical problem-oriented practice and nursing strength-based approach in patient care management and delivery. Such ontology encourages the patient to be the true hero or heroine of their health story and enables the full expression of its narration.

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