ORIGINAL ARTICLE

The Gap in Big Data: Getting to Wellbeing, Strengths, and a Whole-person Perspective

大量数据的差距：通往健康、强壮和全人的前景

La carencia de los grandes volúmenes de datos: Conseguir el bienestar, la fuerza y la perspectiva individual completa

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ABSTRACT

Background: Electronic health records (EHRs) provide a clinical view of patient health. EHR data are becoming available in large data sets and enabling research that will transform the landscape of healthcare research. Methods are needed to incorporate wellbeing dimensions and strengths in large data sets. The purpose of this study was to examine the potential alignment of the Wellbeing Model with a clinical interface terminology standard, the Omaha System, for documenting wellbeing assessments.

Objective: To map the Omaha System and Wellbeing Model for use in a clinical EHR wellbeing assessment and to evaluate the feasibility of describing strengths and needs of seniors generated through this assessment.

Methods: The Wellbeing Model and Omaha System were mapped using concept mapping techniques. Based on this mapping, a wellbeing assessment was developed and implemented within a clinical EHR. Strengths indicators and signs/symptoms data for 5 seniors living in a residential community were abstracted from wellbeing assessments and analyzed using standard descriptive statistics and pattern visualization techniques.

Results: Initial mapping agreement was 93.5%, with differences resolved by consensus. Wellbeing data analysis showed seniors had an average of 34.8 (range=22-49) strengths indicators for 22.8 concepts. They had an average of 6.4 (range=4-8) signs/symptoms for an average of 3.2 (range=2-5) concepts. The ratio of strengths indicators to signs/symptoms was 6:1 (range 2.8-9.6). Problem concepts with more signs/symptoms had fewer strengths.

Conclusion: Together, the Wellbeing Model and the Omaha System have potential to enable a whole-person perspective and enhance the potential for a wellbeing perspective in big data research in healthcare.

摘要

背景：电子健康记录（EHR）提供了一种患者健康的临床观点。EHR 数据可由大型数据集提供，并能启动将改变医疗保健研究前景的研究。目前需要能在大型数据集中纳入健康维度和优势的方法。本研究旨在检验健康模型与临床界面术语标准（Omaha 系统）的潜在协调性，用于记录健康评估。

目的：用于描绘临床 EHR 健康评估中使用的 Omaha 系统和健康模型，并评价通过本评估描述老年人体力和需求的可行性。

方法：使用概念绘图技术绘制健康模型和 Omaha 系统。根据本绘图，开发了一种健康评估方法，并在临床 EHR 中予以实施。 从健康评估中提取了居民区中的 5 个老年人体力指标和体征/症状数据，并使用标准描述统计和可视化技术模式进行分析。

结果：初始绘制符合度为 93.5%，分歧通过协商得到解决。健康数据分析显示，22.8 个概念的老年人体力指标平均值为 34.8（范围=22–49）。平均 3.2 个概念（范围=2–5）的体征/症状平均值为 6.4（范围=4–8）。相对体征/症状的体力指标比值为 6:1（范围 2.8–9.6）。体征/症状问题概念优势较小。

结论：总之，健康模型和 Omaha 系统可能在大型医疗数据研究中启动全人前景并提高健康前景研究的潜能。

SINOPSIS

Antecedentes: Los registros sanitarios electrónicos (RSe) proporcionan una visión clínica de la salud del paciente. Se está empezando a disponer de los RSe mediante grandes conjuntos de datos, lo que posibilita una investigación que transformará el panorama de la investigación sanitaria. Se necesitan métodos para incorporar las dimensiones y puntos fuertes del bienestar en los grandes conjuntos de datos. El propósito de este estudio era examinar la posible convergencia del modelo de bienestar con un estándar de terminología con conexión clínica, el sistema Omaha, para documentar las evaluaciones del bienestar.

Objetivo: Planificar el sistema Omaha y el modelo de bienestar para su uso en una evaluación del bienestar de RSe clínicos y evaluar su viabilidad en la descripción de los puntos fuertes y las necesidades de los adultos que surjan de esta evaluación.

Métodos: El modelo de bienestar y el sistema Omaha se elaboraron mediante técnicas de asignación de conceptos. Basándose en esta elaboración, se desarrolló una evaluación del bienestar y se implementó en un RSe clínico. A partir de las evaluaciones del bienestar se extrajeron datos de indicadores de los puntos fuertes y de los signos o síntomas de 5 ancianos que vivían en una comunidad residencial y se analizaron empleando estadísticas descriptivas y técnicas de visualización de patrones estándar.

Resultados: El acuerdo de la asignación inicial fue del 93,5 % con las diferencias resueltas por consenso. El análisis de los datos de bienestar mostró que los ancianos tenían una media de 34,8 (intervalo = 22-49)

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indicadores de puntos fuertes para 22,8 conceptos. Tuvieron una media de 6,4 (intervalo = 4-8) signos/síntomas para una media de 3,2 (intervalo = 2-5) conceptos. La relación entre indicadores de puntos fuertes y signos/síntomas fue de 6:1 (intervalo = 2,8-9,6). Los conceptos problemáticos con más signos/síntomas tuvieron menos puntos fuertes.

Conclusión: Juntos, el modelo de bienestar y el sistema Omaha tienen potencial para poder realizar una perspectiva individual completa y mejorar el potencial de una perspectiva del bienestar en la investigación de grandes volúmenes de datos sanitarios.

BACKGROUND

> *There have been major humanitarian and sociologic failings in medicine, but almost all of them can be attributed to our poor behavior as scientists as we have dealt with problems out of context and ignored data relevant to good medical care.*
> – Larry Weed, 1968[1]

"Big Data" refers to massive streams of digital data originating from diverse and ubiquitous sources, including clinical data.[2] Communities, health systems, and governments aspire toward the goal of a seamless flow of big data at the population level.[3] "Liquid data" refers to granular, interoperable data about people, places, and things that can be pooled for transformation into useful knowledge through rapid computing techniques.[3] In healthcare and health systems, liquid big data are necessary in real time to support healthcare quality and enable population health research.[2-6] Having and using big data expands the potential for discovery of new and hidden patterns that may inform new directions in healthcare research.[2-3]

In the context of health and healthcare, discourse typically refers to big data as repositories of data generated by use of electronic health records (EHRs) to document a clinical view of patient health.[7-14] Some research also suggests that patients may one day contribute to health data repositories through opting to upload personal data from wearable devices or by entering data into personal health records (PHRs) that are linked to EHRs.[12] Given the focus on EHRs, big data, and the potential of big data research to improve health and healthcare quality, it is essential to critically consider the context and paradigm of clinical data especially in regard to emerging concepts such as wellbeing, strengths, and a whole-person perspective. The disease and treatment paradigm of clinical healthcare may be seen as bounded by physical or mental disease or disability. This paradigm fails to acknowledge and address social dimensions of health or other holistic notions such as strengths or wellbeing.[13-16] Such dimensions of health may play a role in reducing disability and improving functioning and quality of life.[15-17] The clinical EHR based on a disease and treatment paradigm translates to a narrow data set that consists of observational variables that describe what is wrong, what is done, and what is billed. This manifests within the EHR as problem, intervention, and cost concepts, which are entered as structured information in the form of assessments, physiological measures, laboratory values, medication records, claims data, and other clinical and administrative components.[7-14] Thus, use of data elements that originate in EHRs for big data research will produce results that are biased by the limited paradigm of disease and treatment clinical healthcare and fail to demonstrate whole-person health or wellbeing, especially for patients living with chronic health conditions.[17] Looking for wellbeing in such a data set is akin to the streetlight effect: searching for an item "under a streetlight where there is good lighting" nowhere near the actual location of the item.[18]

Wellbeing encompasses a holistic view of physical, mental, and social dimensions and reflects personal meaning, strengths, and interactions of individuals, families, and communities.[17] Numerous models of wellbeing have been proposed to underpin psychological and social functioning.[15-17, 19-20] In the context of global and environmental health, Kreitzer proposed that wellbeing is possible at individual, family, organization or system, and community levels.[15] In Kreitzer's model, the concept of wellbeing incorporates health and extends further to the conditions that enable health and healing, in which people and systems are able to optimize their potential and flourish. The Wellbeing Model describes 6 dimensions that impact wellbeing and the ability to flourish at and across every level from individual to global. The dimensions are environment, health, relationships, security, purpose, and community (Figure 1).[15] Environment is defined as "access to nature as well

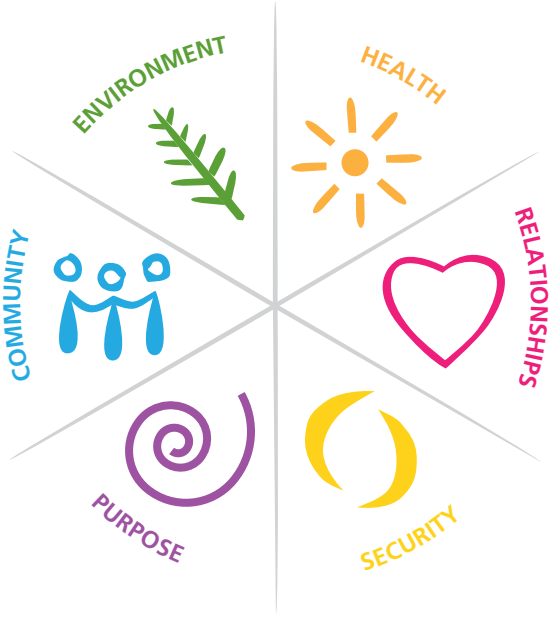

Figure 1 The Wellbeing Model.
Figure used with permission (www.takingcharge.csh.umn.edu/wellbeing-model).

as clean air, water, and toxin free"; health is defined as "physical, emotional, mental, and spiritual health"; relationships encompasses "social connections, networks, and the quality of relationships"; security relates to "basic human needs, stable employment, sufficient finances, and personal safety"; purpose is defined as "an aim and direction, a direct expression of spirituality that gives life and work meaning"; and community is defined as "resources and infrastructure and the extent to which people are engaged and empowered."[15(p707)] The model explains these factors as determinants of wellbeing and provides examples showing their interaction and their impact on health.[15,16]

Consistent with the notion of wellbeing is a strengths perspective that goes beyond determining what is wrong and seeks to understand personal, family, and community assets that may be leveraged to address problems.[21-24] Use of the strengths-based approach has been shown to be effective in improving health for individuals with chronic illness.[21-24] Key to the strengths-based approach in relationship to the Kreitzer Wellbeing Model Dimensions are nonjudgmental interview assessments of patient motivation (purpose), supports (relationships, community), resources (security, environment), and wellbeing (health, including strengths as well as needs).[21]

To avoid looking at problems out of context and to enhance the value of clinical data for strengths-based care, it is essential to identify and implement new models of assessment and data collection that can seamlessly incorporate relevant data in EHRs and PHRs. Likewise, to reduce bias and enhance the value of clinical data for big data research in wellbeing, variables are needed that will expand the perspective of clinical data sets beyond disease, treatment, and cost to move from the narrow focus of what is wrong, what is done, and what is billed toward a wellbeing, strengths, whole-person perspective. The Institute of Medicine (IOM) and others have begun to advocate for expanded documentation of psychosocial variables including the social determinants of health, acknowledging the need for a larger worldview for clinicians and researchers alike.[13,14] However, there is no comprehensive and systematic method of data collection regarding health broadly defined as wellbeing across all determinants and settings. Thus, methods are needed to seamlessly incorporate wellbeing dimensions and strengths indicators within in large data sets together with usual clinical documentation in order to enable meaningful whole-person big data research in health.

Previous research has examined standardized interface terminologies related to health and healthcare that describe the whole person and the variables that will enable examination of health in a comprehensive context.[22-25] One such terminology, the Omaha System, is a multidisciplinary clinical terminology that has the capability of expanding beyond a disease and treatment paradigm to include a strengths-based assessment and approach to care.[22-25]

The Omaha System[26] is a taxonomic health care terminology and measure that enables the management of comprehensive, holistic clinical information in healthcare. It has been widely used in community settings globally, especially in public health and home care.[26-28] There is a growing literature base of healthcare quality research using big data methods with Omaha System data.[27-29] Studies have demonstrated the feasibility of using the Omaha System to describe strengths of patients with chronic illness[24] and to describe interventions of the strengths-based approach[25] and fit within a PHR for use by patients.[30] These preliminary studies suggest there may be potential to operationalize the Wellbeing Model using the Omaha System to enable an expanded perspective within clinical data. The long-term goal of our research is to use the Omaha System to discover novel patterns in large data set research that include wellbeing and strengths. The purpose of this study was to examine the potential alignment of the Wellbeing Model with the Omaha System for documenting wellbeing assessments (Appendix; available at www.gahmj.com). Our objectives were to map the Omaha System and Wellbeing Model for use in a clinical EHR for wellbeing assessment and to evaluate the feasibility of describing strengths and needs of seniors generated through this assessment.

METHODS

This mapping and feasibility study was exempted from review by the Institutional Review Board of the University of Minnesota, Minneapolis. Consent for use of the data was obtained from the residential community leadership.

Sample

A senior living community in the upper Midwest served as the setting. There were 55 residents (39 females, 16 males) with an average age of 85 years. The administrators released 5 wellbeing assessments that were randomly sampled from the EHR, printed, and de-identified for this analysis. The de-identification process resulted in a sample for which no demographics were available.

Instrument

The Omaha System in addition to being a standardized interface terminology for EHRs, is a comprehensive, holistic ontology for health. Using the Omaha System, health information is structured within 42 general concepts (called "problems") that are organized within 4 domains: Environmental, Psychosocial, Physiological, and Health-related Behaviors. These 4 domains represent an ecological perspective of physiological and psychosocial health within the environment, with personal health choices expressed by health-related behaviors.[26,31] The Omaha System has 3 components that enable holistic assessment, care planning and documentation, and outcomes measurement. These components are respectively the Problem Classification Scheme, Intervention Scheme, and Problem Rating Scale for Outcomes. Each of the components includes the 42 problem concepts that together

describe health and wellbeing. This structure aligns with taxonomic, ontological principles for rational organization of healthcare information.[1,32] The Problem Classification Scheme is used to classify health assessments and is the component of the Omaha System that was used in this study. Each of the 42 Omaha System Problem concepts has a neutral definition (Table 1) and unique set of signs/symptoms. For example, the Hearing Problem concept definition is "perception of sound by the ears."[26(p365)] The signs/symptoms for the Hearing Problem concept are "difficulty hearing normal speech tones, difficulty hearing speech in large group settings, difficulty hearing high frequency sounds, absent/abnormal response to sound, and abnormal results of hearing screening test."[26(p366)]

Mapping Procedure

For Aim 1, the Wellbeing Model was mapped to the Omaha System using concept mapping techniques.[24,31] First, the Wellbeing Model concepts were mapped to Omaha System concepts independently by two content experts. These two mappings were com-

Table 1 Wellbeing[15,16] Mapped to the Omaha System[26] Domains and 42 Problem Concepts

Wellbeing Dimension[15(p707)]	Omaha System Domain	Concept	Definition[26]
Community "Resources and infrastructure and the extent to which people are engaged and empowered"	Psychosocial	Communication with community resources	"Interaction between the individual/family/community and social service organizations, schools, and businesses in regard to services, information, and goods/supplies."[26(p362)]
Community	Health-related Behaviors	Health care supervision	"Management of the health care treatment plan by health care providers." [26(p372)]
Environment "Access to nature as well as clean air, water, and toxin free"	Environmental	Sanitation	"Environmental cleanliness and precautions against infection and disease."[26(p361)]
Environment	Environmental	Residence	"Living area."[26(p361)]
Environment	Environmental	Neighborhood/ workplace safety	"Freedom from illness, injury or loss in the community or place of employment."[26(p362)]
Health "Physical, emotional, mental, and spiritual health"	Psychosocial	Abuse	"Child or adult subjected to nonaccidental physical, emotional, or sexual violence or injury."[26(p365)]
Health	Physiological	Hearing	"Perception of sound by the ears."[26(p365)]
Health	Physiological	Vision	"Act or power of sensing with the eyes."[26(p366)]
Health	Physiological	Oral health	"Condition of the mouth and gums and the number, type, and arrangement of the teeth."[26(p366)]
Health	Physiological	Cognition	"Ability to think and use information."[26(p366)]
Health	Physiological	Pain	"Unpleasant sensory and emotional experience associated with actual or potential tissue damage."[26(p367)]
Health	Physiological	Consciousness	"Awareness of and responsiveness to stimuli and the surroundings."[26(p367)]
Health	Physiological	Skin	"Natural covering of the body."[26(p367)]
Health	Physiological	Neuro-musculo-skeletal function	"Ability of nerves, muscles, and bones to perform or coordinate specific movement, sensation, or regulation."[26(p368)]
Health	Physiological	Respiration	"Inhaling and exhaling air into the body and exchanging oxygen."[26(p368)]
Health	Physiological	Circulation	"Pumping blood in adequate amounts and pressure throughout the body."[26(p368)]
Health	Physiological	Digestion-hydration	"Process of converting food into forms that can be absorbed and assimilated, and maintain fluid balance."[26(p369)]
Health	Physiological	Bowel function	"Transporting food through the gastrointestinal tract to eliminate wastes."[26(p369)]
Health	Physiological	Urinary function	"Production and excretion of urine."[26(p369)]
Health	Physiological	Reproductive function	"Condition of the genital organs and breasts and the ability to reproduce."[26(p370)]

Table continued on the next page.

Table 1 Wellbeing[15-16] Mapped to the Omaha System[26] Domains and 42 Problem Concepts (*cont.*)

Wellbeing Dimension[15(p707)]	Omaha System Domain	Concept	Definition[26]
Health	Physiological	Pregnancy	"Period from conception to childbirth."[26(p370)]
Health	Physiological	Postpartum	"Six-week period following childbirth."[26(p370)]
Health	Physiological	Communicable/ infectious condition	"State in which organisms invade/infest and produce superficial or systemic illness with the potential for spreading or transmission."[26(p370)]
Health	Health-related Behaviors	Nutrition	"Select, consume, and use food and fluids for energy, maintenance, growth, and health."[26(p371)]
Health	Health-related Behaviors	Sleep and rest patterns	"Periods of suspended motor and sensory activity and periods of inactivity, repose, or mental calm."[26(p371)]
Health	Health-related Behaviors	Physical activity	"State or quality of body movements during daily living."[26(p371)]
Health	Health-related Behaviors	Personal care	"Management of personal cleanliness and dressing."[26(p372)]
Health	Health-related Behaviors	Substance use	"Consumption of medicines, recreational drugs, or other materials likely to cause mood changes and/or psychological/ physical dependence, illness, and disease."[26(p372)]
Health	Health-related Behaviors	Family planning	"Practices designed to plan and space pregnancy within the context of values, attitudes, and beliefs."[26(p372)]
Health	Health-related Behaviors	Medication regimen	"Use or application of over-the-counter and prescribed/ recommended medications and infusions to meet guidelines for therapeutic action, safety, and schedule."[26(p373)]
Purpose "An aim and direction, a direct expression of spirituality that gives life and work meaning"	Psychosocial	Role change	"Additions to or removal of a set of expected behavioral characteristics."[26(p363)]
Purpose	Psychosocial	Spirituality	"Beliefs and practices that involve faith, religion, values, the spirit, and/or the soul."[26(p363)]
Purpose	Psychosocial	Mental health	"Development and use of mental/emotional abilities to adjust to life situations, interact with others, and engage in activities."[26(p363)]
Relationships "Social connections, networks, and the quality of relationships"	Psychosocial	Social contact	"Interaction between the individual/family/community and others outside the immediate living area."[26(p362)]
Relationships	Psychosocial	Interpersonal relationship	"Associations or bonds between the individual/family/ community and others."[26(p363)]
Relationships	Psychosocial	Grief	"Suffering and distress associated with loss."[26(p363)]
Relationships	Psychosocial	Sexuality	"Attitudes, feelings, and behaviors related to intimacy and sexual activity."[26(p364)]
Relationships	Psychosocial	Growth and development	"Progressive physical, emotional, and social maturation along the age continuum from birth to death."[26(p365)]
Security "Basic human needs, stable employment, sufficient finances, and personal safety"	Environmental	Income	"Money from wages, pensions, subsidies, interest, dividends, or other sources available for living and health care expenses."[26(p361)]
Security	Psychosocial	Caretaking/parenting	"Providing support, nurturance, stimulation, and physical care for dependent child or adult."[26(p364)]
Security	Psychosocial	Neglect	"Child or adult deprived of minimally accepted standards of food shelter, clothing, or care."[26(p365)]
Security	Physiological	Speech and language	"Use of articulated vocal sounds, symbols, signs, or gestures for communication."[26(p366)]

bined in a single document and reviewed by a Wellbeing Model expert and an Omaha System expert. Differences were resolved by consensus. Based on the final mapping, an Omaha System–Wellbeing Model assessment was adopted by nursing leaders for use in a senior residential community and incorporated within the existing clinical EHR. The comprehensive assessment included 37 Omaha System Problem concepts that operationalized the 6 dimensions of the Wellbeing Model specifically for seniors living in a residential community. Five Omaha System Problem concepts were not selected for the assessment, including Pregnancy, Postpartum, Reproductive function, Family planning, and Growth and development.

Wellbeing Data Collection and Analysis

Wellbeing assessments were completed by a registered nurse. Upon community entry, each resident was offered an assessment to establish a wellbeing baseline. Wellbeing assessments were repeated with any change of condition, reflecting strength or limitation change, and every 60 to 90 days per state regulatory guidelines. Aim 2 used assessment data that were recorded by registered nurses with bachelor's-, master's-, or doctoral-level preparation who conducted a comprehensive interview assessment with seniors joining the residential community. Structured data entry for strengths indicators and signs/symptoms of 34 Problem concepts were documented by nurses in the process of routine documentation if relevant to the resident (the earliest version of the wellbeing assessment included 34 of the 37 selected Omaha System Problem concepts). Printed copies of 5 assessments were de-identified and provided to the research team. The strengths indicators and signs/symptoms data were entered by the researchers into an Excel spreadsheet with Omaha System Problem concepts as the organizing framework. Data were analyzed to examine the feasibility of assessing the overall wellbeing and the relationships between strengths and needs of community-dwelling seniors, using Microsoft Excel 2013 (Microsoft Corp, Redmond, Washington)for standard descriptive statistics and pattern visualization techniques.

RESULTS

Omaha System Problem concepts mapped successfully to the Wellbeing Model (Tables 1 and 2). There was 93.8% agreement between the initial mappings by the two content experts. Full agreement was reached by consensus of the content experts and model experts. Each Wellbeing Model Dimension mapped to multiple Omaha System Concepts. There was a range of 2 to 5 concepts per Wellbeing Dimension, with the exception of the Health Dimension, which had 25 concepts. Three Problem concepts mapped to the Wellbeing Model Environment Dimension were from the Omaha System Environmental Domain. Eight concepts mapped to the Wellbeing Model Relationships and Purpose Dimensions were from the Omaha System Psychosocial Domain. Two Problem concepts mapped to the Wellbeing Model Community Dimensions were from the Omaha System Psychosocial and Health-related Behaviors Domains, and 4 Problem concepts mapped to the Wellbeing Security Dimension were from the Omaha System Environmental, Psychosocial, and Physiological Domains. Finally, 25 concepts mapped to the Wellbeing Model Health Dimension were from the Omaha System Psychosocial, Physiological, and Health-related Behaviors Domains. The mapping is depicted visually in Figure 2 to show alignment of the models, with colors representing the Wellbeing Model Dimensions and rings representing the Omaha System Domains.

To apply the Omaha System within a whole-person assessment, the nurses at the residential community developed a set of neutral assessment questions and one or more strengths indicators for each Problem concept. These were incorporated within the assessment protocol in addition to the Problem-specific signs/symptoms. An example of the wellbeing whole-person assessment for the Social Contact Problem concept (Relationship Dimension—Psychosocial Domain) defined as "Interaction between the individual and others outside the immediate living area"[26(p362)] includes the prompt, "Tell me about your social activity/friendships, significant people in your life, and things you enjoy doing" and the strengths indicator "extensive family engagement." Signs/symptoms of the Social Contact Problem are "limited social contact, uses healthcare provider for social contact, and minimal outside stimulation/leisure time activities."[26(p362)] An example of the wellbeing whole-person assessment as it appears in a paper form for the Skin Problem (Health Dimension—Physiological Domain) is shown in Figure 3.

A proprietary software system already in use at the residential community was retrofitted in the resident assessment documentation section to include Omaha System terms as described above, including the

Table 2 Number of Omaha System[26] Problem Concepts by Omaha System Domain and Wellbeing Model Dimension[15-16]

Omaha System Domain/ Wellbeing Model Dimension	Environment[a]	Purpose[a]	Relationships[a]	Community[b]	Security[b]	Health[b]	Total
Environmental	3				1		4
Health-related Behaviors				1		7	8
Physiological					1	17	18
Psychosocial		3	5	1	2	1	12
Total	3	3	5	2	4	25	42

[a] One Wellbeing Model Dimension mapped to one Omaha System Domain
[b] One Wellbeing Model Dimension mapped to more than one Omaha System Domain

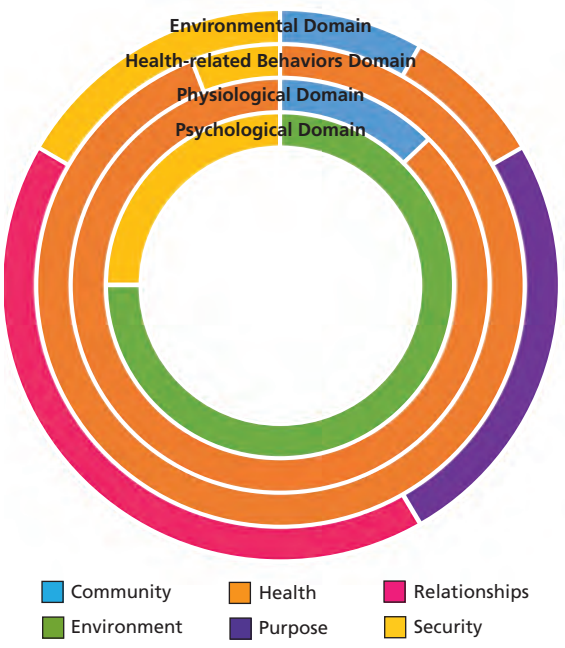

Figure 2 Mapping of the Omaha System[26] and Wellbeing Model[15-16] by domain (rings).

Figure reprinted with permission from the Minnesota Omaha Systems Users Group. Colors indicate Wellbeing Model Dimensions. Rings show Omaha System Domains.

Problem concept–specific assessment questions, strengths indicators, and signs/symptoms. Despite providing screens for structured data entry, the software system did not build in new functionality to export, aggregate, or report this wellbeing assessment data nor link to plan of care functionality.

Data from wellbeing assessments of 5 seniors described both strengths and needs. Strengths indicators were selected for all Problem concepts except Vision. Seniors had an average of 34.8 (range=22-49) strengths indicators for 22.8 (range=16-29) Problem concepts (Table 3). They had an average of 6.4 (range=4-8) signs/symptoms for 3.2 (range=2-5) Problem concepts. The ratio of strengths indicators to signs/symptoms was 6:1 (range 2.8:1-9.6:1). Patterns in the data reflected inverse relationships between strengths and signs/symptoms by Problem concept (Figure 4). Problem concepts with the most signs/symptoms were Vision, Neuro-musculoskeletal function, Circulation, and Hearing (Figure 4). Signs/symptoms were most frequent in the Omaha System Physiological Domain and Wellbeing Health Dimension, and strengths indicators were most frequent in the Omaha System Psychosocial Domain and the Wellbeing Relationship Dimension.

DISCUSSION

This is the first study to examine clinical assessment data from a wellbeing perspective. Results demonstrate the feasibility of using the Wellbeing Model, the Omaha System, and the strengths approach to achieve the goal of a whole-person perspective in clinical data. Furthermore, it was feasible to describe and document both strengths and signs/symptoms of seniors in residential communities for 34 Omaha System Problem concepts. Thus, there is potential to generate large clinical data sets from PHRs and EHRs that can be mined to discover new patterns in wellbeing and healthcare using a clinical terminology standard.

The Wellbeing Model is a theoretical framework that aids in exploring the meaning of wellbeing for individuals, families, communities, and systems. The Omaha System is an information model that enables comprehensive holistic assessment, care planning, documentation, and outcome measurement. The finding of very high level of agreement across content expert mappings is unusual and may indicate that the Wellbeing Model and Omaha System share a basis in sound holistic health science. Further research is needed to evaluate and validate this mapping and its associated wellbeing assessment tools, including strengths indicators.

These 2 comprehensive, holistic models of health and healthcare serve different purposes. The notion that the Omaha System, a recognized international clinical terminology standard, can operationalize the Wellbeing Model theoretical framework is key to accurate and comprehensive knowledge representation of the Wellbeing Model in clinical EHRs and PHRs. Such implementation within EHRs and PHRs is in turn necessary for data capture in large data sets. For example, PHRs are thought to be a mechanism for engaging patients in their care and exchanging data with clinicians and perhaps augmenting clinical data by adding patient-reported information, including patient-reported strengths.[12]

Mapping between Wellbeing dimensions and Omaha System Domains offers interesting conceptual insights. Alignment between the Environment Dimension and the Environmental Domain and like-

Section Skin (Wellbeing)

Do you have any areas of your skin that are reddened or have open sores that you are concerned about? (Select all that apply)

- ❑ 00 No skin concerns noted; usual skin condition present per resident/responsible party
- ❑ 00 Uses good personal hygiene and changes position often to support good skin care
- ❑ 01 Lesion/pressure ulcer
- ❑ 02 Rash
- ❑ 03 Excessively dry
- ❑ 04 Excessively oily/moisture
- ❑ 05 Inflammation
- ❑ 06 Pruritus
- ❑ 07 Drainage
- ❑ 08 Bruising
- ❑ 09 Hypertrophy of nails

Figure 3 Wellbeing Assessment—Skin (Health Dimension—Physiological Domain).[15,16,26] Strengths indicators are labeled "00." Signs/symptoms are enumerated according to Omaha System coding structure.

Table 3 Number of Omaha System[26] Problem Concepts in Wellbeing Assessment Data of Seniors Living in Residential Communities by Omaha System Domain and Wellbeing Model Dimension[15,16]

Omaha System Domain/ Wellbeing Model Dimension	Environment	Purpose	Relationships	Community	Security	Health	Total
Environmental	2				1		3
Health-related behaviors						6	6
Physiological					1	14	15
Psychosocial		3	5	1	1		10
Total	2	3	5	1	3	20	34

wise between the Relationships and Purpose Dimensions and the Psychosocial Domain show the conceptual alignment between the 2 models. In the case of the Environment Dimension, the definition suggests that a strengths indicator may be "access to nature"; likewise, the corollary "nature deficit" could be recommended for a future revision of the Omaha System as a sign/symptom for a Problem concept in the Environmental Domain, such as Neighborhood/workplace safety.

Alignment between Community and the Psychosocial and Health-related Behaviors Domains suggests that there are both behavioral and psychological dimensions of wellbeing in Community. The finding that Security mapped to Problem concepts in the Environmental, Psychosocial, and Physiological Domains demonstrates the multifaceted aspects of security that broadly underlie health. The finding that the Health Dimension mapped to Problem concepts from Psychosocial, Physiological, and Health-related Behaviors Domains is consistent with the primary focus of the Omaha System as a structured ontology for health and healthcare. The fact that all Wellbeing Dimensions and Omaha System Problem concepts were mapped suggests that data from wellbeing assessments using the Omaha System would comprehensively depict wellbeing, capture strengths and needs in a whole-person

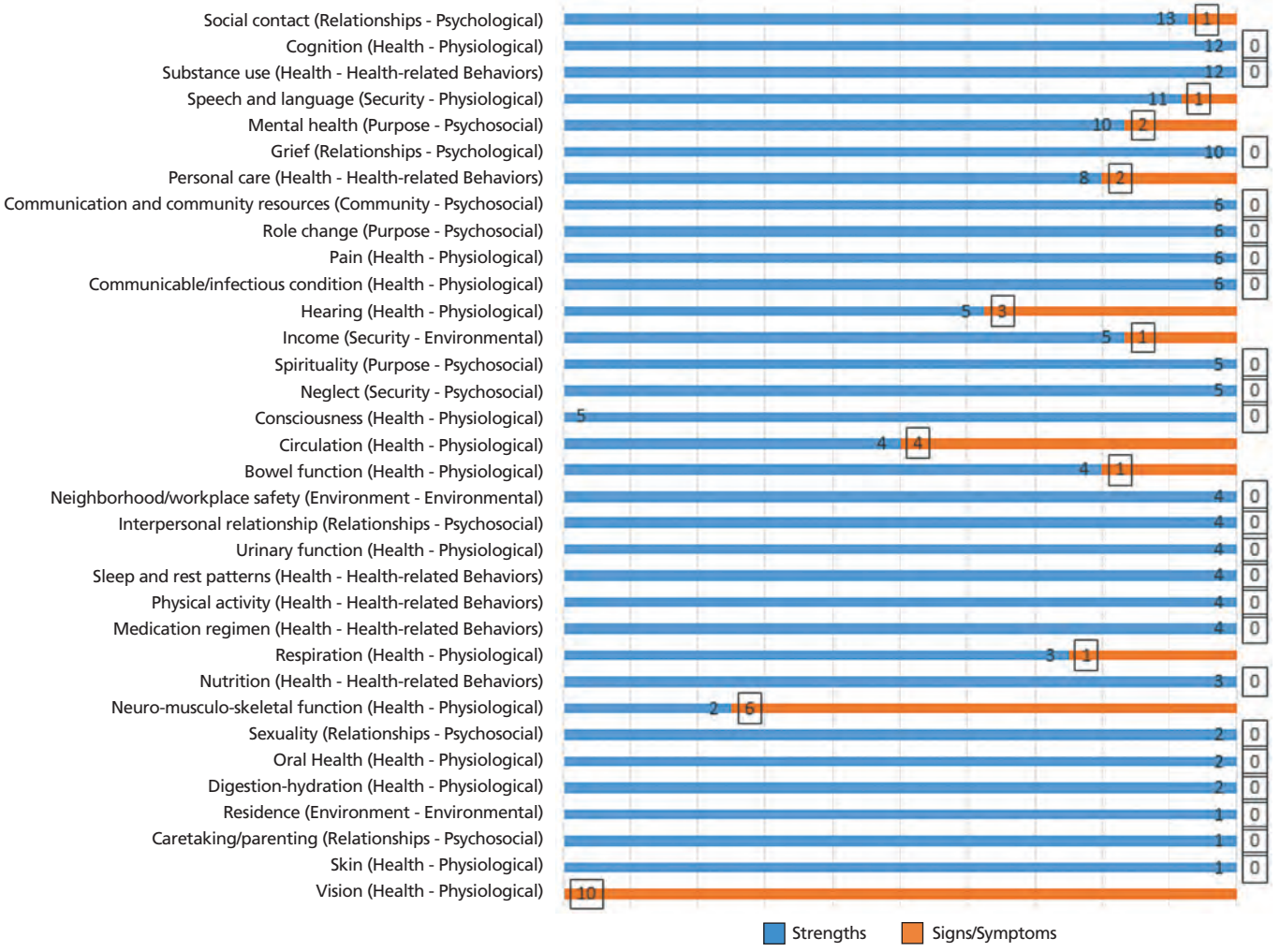

Figure 4 Strengths and signs/symptoms by Omaha System Concept, Wellbeing Model Dimension, and Omaha System Domain among seniors living in residential communities.[15,16,26]

perspective, and enable large data set research to discover patterns in wellbeing.

The Omaha System has been successfully implemented in a number of clinical software applications that are widely used in community settings in the United States and internationally.[26] The limited functionality of the software used for the wellbeing assessment in this study demonstrated challenges faced by clinicians who desire to improve documentation practices within established EHRs. The fact that the wellbeing assessment data could not be accessed from the EHR in this study points to the need for leaders to understand basic principles of data management in order to make informed decisions about clinical software. Furthermore, the inability to link assessments to care plans and outcome measures points to the importance of improved software development based on sound taxonomic principles that can comprehensibly link data in a taxonomic ontological structure, as suggested by Weed,[1] Martin,[26] Cimino,[32] and others. Further research is needed to understand best practices in software development that support holistic practice, improve clinical workflow, and enable structured wellbeing documentation, thus enabling capture of structured robust, relational data for clinical use, evaluation, and research.

Due to the software limitations, manual data extraction from printed wellbeing assessments was necessary and limited our analysis. Only 5 records were randomly sampled for the second aim of this study. Nevertheless, the finding that strengths indicators were most likely in the Psychosocial Domain is consistent with previous research evaluating strengths of adults with multiple chronic conditions.[24] These preliminary findings showed that the ratio of strengths to signs/symptoms was consistently high in this sample and that Problem concepts with more signs/symptoms had fewer strengths. Such patterns are of interest and may provide a glimpse of possible big data research in wellbeing and healthcare. Further research is needed to examine these and other whole-person patterns in large data sets. The research agenda that is emerging from this structured whole person assessment approach is extensive. Future research can incorporate variables from a perspective that describe overall wellbeing including strengths indicators, which may be associated with health outcomes.

CONCLUSION

This study demonstrated the feasibility of using the Omaha System in EHRs to operationalize wellbeing as described by Kreitzer.[15] The wellbeing assessment included both strengths indicators and signs/symptoms for 34 concepts and enabled a whole-person assessment of strengths and needs of seniors in a residential community. Wellbeing assessment data revealed an inverse relationship between strengths and needs among seniors living in a residential community. Together, the Wellbeing Model, a strengths-based assessment, and the Omaha System have potential to fill the gap in big data and illuminate whole-person big data research.

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