AMIA
INFORMATICS PROFESSIONALS. LEADING THE WAY.   OXFORD

Perspective

Future advancement of health care through standardized nursing terminologies: reflections from a Friends of the National Library of Medicine workshop honoring Virginia K. Saba

Karen Dunn Lopez [iD][1],*, **Laura Heermann Langford**[2], **Rosemary Kennedy**[3], **Kathleen McCormick**[4], **Connie White Delaney**[5], **Greg Alexander** [iD][6], **Jane Englebright**[7], **Whende M. Carroll**[8], and **Karen A. Monsen** [iD][5]

[1]Division of Acute and Critical Care, The University of Iowa, College of Nursing, Iowa City, IA, USA, [2]University of Utah, College of Nursing, Salt Lake City, UT, USA, [3]Health Informatics, Connect America, Bala Cynwyd, PA, USA, [4]SciMind, LLC, North Potomac, MD, USA, [5]University of Minnesota School of Nursing, Minneapolis, MN, USA, [6]Columbia University, School of Nursing, New York, NY, USA, [7]Nashville, TN, USA, and [8]Healthcare Information Management and Systems Society (HIMSS), Chicago, IL, USA

*Corresponding Author: Karen Dunn Lopez, PhD, MPH, RN, FAAN, Division of Acute and Critical Care, The University of Iowa, College of Nursing, 456 CNB, 50 Newton Rd, Iowa City, IA 52242, USA; karen-dunn-lopez@uiowa.edu

ABSTRACT

Objective: To honor the legacy of nursing informatics pioneer and visionary, Dr. Virginia Saba, the Friends of the National Library of Medicine convened a group of international experts to reflect on Dr. Saba's contributions to nursing standardized nursing terminologies.

Process: Experts led a day-and-a-half virtual update on nursing's sustained and rigorous efforts to develop and use valid, reliable, and computable standardized nursing terminologies over the past 5 decades. Over the course of the workshop, policymakers, industry leaders, and scholars discussed the successful use of standardized nursing terminologies, the potential for expanded use of these vetted tools to advance healthcare, and future needs and opportunities. In this article, we elaborate on this vision and key recommendations for continued and expanded adoption and use of standardized nursing terminologies across settings and systems with the goal of generating new knowledge that improves health.

Conclusion: Much of the promise that the original creators of standardized nursing terminologies envisioned has been achieved. Secondary analysis of clinical data using these terminologies has repeatedly demonstrated the value of nursing and nursing's data. With increased and widespread adoption, these achievements can be replicated across settings and systems.

Key words: standardized nursing terminologies, nursing care, population health, health care policies

BACKGROUND

In October 2022, the Friends of the National Library of Medicine (FNLM) convened international leaders to honor the legacy of nursing informatics Dr. Virginia Saba. Dr. Saba, who spearheaded the specialty of nursing informatics and developed the Clinical Care Classification (CCC) system,[1] was an innovator, scholar, visionary, leader, and mentor. She inspired many in the nursing informatics community to achieve lofty goals related to development, recognition, implementation, and use of standardized nursing terminologies.

These key leaders provided updates regarding nursing's sustained and rigorous efforts to develop and use valid, reliable, and computable standardized nursing terminologies over the past 5 decades. This led to an FNLM-sponsored virtual one-and-a-half day workshop titled *Honoring the legacy of Virginia Saba through charting a path forward for standardized nursing terminologies in practice and research* (See

Supplemental File 1 for workshop agenda, recording available at https://www.fnlm.org/product/video-honoring-the-legacy-of-virginia-saba-through-charting-a-path-forward-for-standardized-nursing-terminologies-in-practice-and-research/).[2]

STANDARDIZED NURSING TERMINOLOGY OVERVIEW AND BRIEF HISTORY

Standardized nursing terminologies are knowledge representation systems that reflect the domain of nursing practice. Unlike terms that focus on medical diagnosis, surgeries, and treatments, nursing diagnoses are terms for health problems in which decisions can be made within the scope and practice of a professional nurse, nursing interventions describe what nurses do to impact patient outcomes, and nursing outcomes are states that are measured on a continuum in response to a nursing intervention. The first conference on the classification of nursing diagnoses was held in 1973.[3] In the 1980s, The

Nursing Minimum Data Set delineated the information needed about each patient to determine nurses' contributions to patient care, generate new nursing knowledge, and make contributions to public policy.[4] This includes demographic elements, nursing care elements (nursing diagnoses, nursing interventions, nursing outcomes, nursing care intensity), and service elements (eg, admission/discharge dates, disposition). The core knowledge representation structures of nursing diagnoses (problems), interventions, and outcomes are captured by terminologies that have been recognized by the American Nurses Association: the Clinical Care Classification (CCC),[5] the International Classification for Nursing Practice,[6] NANDA-I,[7] Nursing Interventions Classification,[8] Nursing Outcomes Classification,[9] the Omaha System,[10] and the Perioperative Nursing Data Set.[11]

UNPARALLELED SUCCESS OF NURSING TERMINOLOGY IN THE WORLD OF HEALTHCARE STANDARDS

The workshop presenters shed light on the unparalleled success of nursing terminology in the world of healthcare standards, demonstrating the feasibility of the learning health system[12] based on standardized data and improving population health through the use of informatics tools and techniques.[13] During the workshop, policy leaders and scholars discussed the successful use of standardized nursing terminologies and the potential for expanded use of these vetted tools to advance healthcare. This robust body of work, often funded by NIH and the Agency for Healthcare Research and Quality and other national funders, for example,[14–18] shows the power of standardized nursing terminologies to create practice-based evidence that supports nurses' decision-making at the bedside.[19] Standardized nursing terminologies are well positioned to help further nursing advance nursing science,[20–22] care quality,[23–25] and equity.[26–29]

VISION

Standardized nursing terminology creators envisioned that the terminologies would be used widely in clinical practice and would create usable data through routine nursing documentation that could make visible the value of nursing care on patient outcomes and advance nursing knowledge.[1,30] Their research began with clinical experts proposing and defining comprehensive nursing terms nested in hierarchies,[3,30,31] linking diagnoses, interventions, and outcomes,[32–35] and progressed to extensive-term validation as well as descriptive research of nursing care provided focusing on different settings and conditions.[36] In the last decade, research using large, standardized nursing terminology datasets has advanced to make predictions about patient outcomes and improve intervention effectiveness using various inferential statistics and data science methods.[23,37–50]

Even so, barriers to this path forward remain. The purpose of this article is to synthesize key takeaways from the FNLM workshop and propose strategic paths forward to optimize standardized nursing terminology use. The most important overall messages from this endeavor are that (1) standardization is as useful as Dr. Saba and the nursing informatics pioneers anticipated it would be and (2) the power of these nursing innovations should not be underestimated or withheld from arenas in which they have yet to be leveraged for the greater good.

STRATEGIC PATH FORWARD

The following takeaways from the workshop are priorities for advancing the adoption and use of standardized nursing terminologies (Figure 1).

1) Reduce documentation burden. The urgent need to reduce documentation burden should be prioritized at all levels.[51] Implementation of standardized nursing terminology, along with user-centered design and guidance from implementation science is key to this priority. Where standardized nursing terminologies are employed, there is a common language with validated psychometric properties that improves communication, and we see improvement in clinicians' thought landscape and healthcare quality and outcomes.[19,52–56] First and foremost, existing nursing documentation should support the clinician's workflow and thought processes; enhance interprofessional communication and leveraging the secondary use of their data to improve quality and value.

2) Advance adoption. There is an immense opportunity to improve population health across the continuum of care by the wide use of these rigorously developed standardized nursing terminologies in EHRs.[54,57–59] Industry/vendor leaders should adopt and use these recognized standardized nursing terminologies correctly, rather than proprietary documentation methods that do not reflect the reliability, validity and overall rigor of the existing standardized nursing terminologies. Importantly, proprietary industry/vendor terms are not interoperable with other standardized datasets required to create shareable data and important new knowledge that improves population health.

3) Partner with practice. Experts in standardized nursing terminology use, implementation, and research must make their expertise accessible to Chief Nursing Officers, educators, practicing nurses, and industry. A think-tank of leaders could be a valuable start to improve partnering to understand stakeholders' needs and ensure that no stakeholder must "reinvent the wheel" when developing or implementing a value set, EHR, PHR, or consumer-facing data collection tool. Creating a repository of success stories and strategies for diverse uses of standardized nursing terminologies across platforms and settings within the National Library of Medicine UMLS would be a great asset for multiple stakeholders.[57,60,61]

4) Enable competency development. There is a critical need for additional nursing informatics faculty, particularly experts in terminologies. Creative collaborations are needed to help share expertise, curricula, and other educational resources.[62] This will enable entry-level nurses to describe the importance of standardized nursing terminologies and enable advanced-level nurses to clarify how collecting standardized nursing data will advance the practice of nursing and shed light on the value of nurses' contributions. The importance of these competencies has recently been endorsed by the American Association of Colleges of Nurses.[63]

5) Enhance interoperability. Interoperability issues would be mitigated through embedding standardized nursing

Figure 1. Strategic paths forward to optimize standardized nursing terminologies use.

terminologies at all points in the care continuum.[64] For example, existing documentation could be harvested and embedded into FHIR profiles,[60] quality measures, value-based care, or continuity of care documents.[65,66] Nursing terminologies all represent the same domain of knowledge. Leaders should make an informed choice on which terminology to use (including evidence base and development rigor) and use it correctly according to specifications for that terminology. Policymakers and nursing leaders must advocate for nursing's presence in interoperability conversations of all types.

6) Generate new knowledge. The discipline of nursing has a moral imperative to use our data to create new knowledge and improve the quality of care and population health.[67] The collective achievements of all standardized nursing terminologies demonstrate nursing researchers' responses to this imperative, and a deep respect for the practicing nurses who generate data. We must continue to advance research by developing large shareable nursing terminology datasets toward the goal of optimizing patient and population health outcomes through the highest quality care at the best value.[20,68–70]

7) Improve health equity. Although major initiatives are currently underway to identify social and behavioral determinants of health for documentation, standardized nursing terminologies have long-established, robust sets of terms to fit this need, and are yet mostly overlooked outside of, and sometimes even within, the nursing domain.[71] Social determinants documentation is another example of the

successful reuse of existing data to meet a need that appeared to be novel but in fact was already extant within systems using standardized nursing terminology as a foundation for assessments and documentation.[28,29,72–76]

8) Integrate with Industry 4.0 Innovations.[77] Industry 4.0 in healthcare involves the use of a wide range of modern technologies including digitization, artificial intelligence, user response data (ergonomics), human psychology, the Internet of Things, machine learning, big data mining, and augmented reality (Figure 2). Together with Industry 4.0, digital healthcare, sensor technologies, management of large datasets, robotics, and AI are forcing a different mindset of where care is delivered, how nurses make decisions, and how value is measured. Care delivery venues are expanding beyond traditional healthcare settings, with nurses practicing in retail pharmacies, virtual care centers, payer settings, and community service centers. These innovations will benefit from the collection of standardized nursing data, analysis, reporting, and quality measurement methods in areas where patients or residents have different sets of nursing interventions that historically were not part of care.[27,78–81]

9) Expand interdisciplinary and consumer use. Standardized nursing terminologies may be adopted and used by any health care discipline or consumer group.[10,82,83] In this article, we focus on nursing specifically; however, we heartily endorse standardization across disciplines and support all who may be interested in the benefits of standardization to guide, document, evaluate, and improve

Figure 2. Industry 4.0 Innovations with potential for use of standardized nursing terminologies. © Rosemary Kennedy, all rights reserved, reprinted with permission.

healthcare. Lessons learned from the 5 decades of standardized terminology development and use in nursing practice, education, and research may be generalizable and should be shared widely. Many of the terms are suitable for physical and occupational therapy, 2 disciplines that primarily rely on narrative documentation that obscures the contributions these 2 disciplines make to patient care outcomes.[84] CCC has also been used for Respiratory Therapy documentation. As people with chronic illnesses continue to grow, standardized nursing terminologies can also be simplified to allow consumers to track chronic health concerns and provide meaningful data for visits with providers.

10) Obtain federal support. Similar to the way SNOMED CT[85] and LOINC[86] are supported at a federal level or by international organizations, the National Library of Medicine, the Centers for Medicare and Medicaid Services, and/or the Office of the National Coordinator could provide policy support to encourage adoption as well as financial support for use of all nursing terminologies to address licensing issues that create barriers for the use of some standardized terminologies.[87] Now that many nurses lead major national initiatives and organizations, the nursing discipline has achieved a level of influence that could successfully address this challenge.

CONCLUSION

Ultimately, standardized nursing terminologies bring value. The FNLM workshop honoring Dr. Virginia Saba's legacy provided a glimpse into their potential. Standardized nursing terminology leaders see the value in one another's work and

are actively collaborating to support one another's efforts, agreeing that a "win" for 1 terminology is a "win" for all. In addition, speakers demonstrated that much of the envisioned standardized nursing terminology potential has been achieved; that the value of nursing has been proven repeatedly; that the return of practice-based evidence into practice is real; and that these achievements can be replicated across settings and systems. This can no longer be denied; therefore, let us work together to extend and expand the benefits of nursing terminologies to create the lasting impact that nursing informatics pioneers envisioned.

FUNDING

AUTHOR CONTRIBUTIONS

All authors contributed to the conception and design, drafting, final review of submission, and agreed to be accountable for all aspects of the work.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Journal of the American Medical Informatics Association* online.

REFERENCES

1. American Medical Informatics Association, NIWG. *Nursing Informatics History Project*; 2023. https://amia.org/community/working-groups/nursing-informatics/nursing-informatics-history-project. Accessed July 31, 2023.
2. Dunn Lopez K, McCormick K. Embarking on a New Era for Standardized Nursing Terminologies. *Comput Inform Nurs* 2023; 41 (1): 6–7.
3. Gebbie KML. *Proceedings of the First National Conference on the Classification of Nursing Diagnoses*. St. Loius: Mosby; 1975.
4. Werley HH, Lang NM, Westlake SK. The nursing minimum data set conference: executive summary. *J Prof Nurs* 1986; 2 (4): 217–24.
5. Saba V. *Clinical Care Classification (CCC) System Version 2.5: User's Guide*. New York, NY: Springer Publishing Company; 2012.
6. Marucci AR, De Caro W, Petrucci C, Lancia L, Sansoni J. ICNP-International Classification of Nursing Practice: origin, structure and development. *Prof Inferm* 2015; 68 (2): 131–40.
7. Herdman H, Kamitsuru S, Lopez C. *Nursing Diagnoses: Definitions and Classification 2021-2023*. 12th ed. New York, NY: Thieme; 2021.
8. Wagner CM, Butcher HK, Clarke MF. *Nursing Interventions Classification (NIC)*. 8th ed. St. Loius, MO: Elsevier; 2023.
9. Moorhead S, Swanson E, Johnson M. *Nursing Outcome Classification*. 7th ed. St. Loius, MO: Elsevier; 2024.
10. Martin K. *The Omaha System: A Key to Practice, Documentation, and Information Management*. 2nd ed. Omaha, NE: Health Connections Press; 2005.
11. Petersen C, Kleiner C. Evolution and revision of the perioperative nursing data set. *AORN J* 2011; 93 (1): 127–32.
12. Agency for Healthcare Research and Quality. *Defining a Learning Health System*; 2019. https://www.ahrq.gov/learning-health-systems/about.html.
13. Lopez KD, Febretti A, Stifter J, *et al*. Toward a more robust and efficient usability testing method of clinical decision support for nurses derived from nursing electronic health record data. *Int J Nurs Knowl* 2017; 28 (4): 211–8.
14. McCloskey JC. *Classification of Nursing Interventions*. National Institue of Health; 1990–1992.
15. Johnson M. *Evaluation of Nursing Sensitive Patient Outcome Measures*; 1999–2001.
16. Keenan G. *HIT Support for Safe Nursing Care*; 2004–2006.
17. Keenan W. *Describing, Contrasting, and Visualizing End-of-Life Care in the 21st Century*; 2011–2014.
18. Maciera T, Keenan G, Yao Y. *Harmonizing and Integrating Nursing Data into Multidisciplinary Datasets to Evaluate Hospital Care and Readmissions of Older Adults with Alzheimers Disease and Alzheimers Disease-Related Dementias*. National Institute of Health, National Institute of Aging; 2021–2023.
19. Laker LF, Froehle CM, Windeler JB, *et al*. Quality and efficiency of the clinical decision-making process: Information overload and emphasis framing. *Prod Oper Manag* 2018; 27 (12): 2213–25.
20. Schwartz CI, Farag A, Lopez KD, *et al*. Using Omaha System data to explore relationships between client outcomes, phenotypes, and targeted home intervention approaches: an exemplar examining practice effectiveness for older women with circulation problems. *J Am Med Inform Assoc* 2023; ocad106.
21. Cesare M, D'agostino F, Maurici M, *et al*. Standardized nursing diagnoses in a surgical hospital setting: a retrospective study based on electronic health data. *SAGE Open Nurs* 2023; 9.
22. Bertocchi L, Dante A, La Cerra C, *et al*. Impact of standardized nursing terminologies on patient and organizational outcomes: A systematic review and meta-analysis. *J Nurs Scholarsh* 2023. doi: 10.1111/jnu.12894.
23. Yao Y, Keenan G, Al-Masalha F, *et al*. Current state of pain care for hospitalized patients at end of life. *Am J Hosp Palliat Care* 2013; 30 (2): 128–36.
24. Titler MG, Shever LL, Kanak MF, *et al*. Factors associated with falls during hospitalization in an older adult population. *Res Theory Nurs Pract* 2011; 25 (2): 127–48.
25. Shever LL, Titler MG, Kerr P, *et al*. The effect of high nursing surveillance on hospital cost. *J Nurs Scholarsh* 2008; 40 (2): 161–9.
26. Austin RR, Martin CL, Jones CR, *et al*. Translation and validation of the Omaha System into English language simplified Omaha System terms. *KONTAKT J Nurs Soc Sci Relat Health Illness* 2022; 24 (1): 48–54.
27. Austin RR, Mathiason MA, Lu S-C, *et al*. Toward clinical adoption of standardized mHealth solutions: the feasibility of using MyStrengths+ MyHealth consumer-generated health data for knowledge discovery. *CIN Comput Inform Nurs* 2022; 40 (2): 71–9.
28. Michalowski M, Austin RR, Mathiason MA, *et al*. Relationships among interventions and health literacy outcomes for sub-populations: a data-driven approach. *Kontakt* 2018; 20 (4): e319–e325.
29. Monsen KA, Brandt JK, Brueshoff BL, *et al*. Social determinants and health disparities associated with outcomes of women of childbearing age who receive public health nurse home visiting services. *J Obstet Gynecol Neonatal Nurs* 2017; 46 (2): 292–303.
30. Maas ML, Johnson M, Moorhead S. Classifying nursing-sensitive patient outcomes. *Image J Nurs Sch* 1996; 28 (4): 295–301.
31. Clark J, Lang N. Nursing's next advance: an internal classification for nursing practice. *Int Nurs Rev* 1992; 39 (4): 109–11, 128.
32. Moorhead S, Macieira TGR, Lopez KD, *et al*. NANDA-I, NOC, and NIC linkages to SARS-Cov-2 (Covid-19): part 1. Community response. *Int J Nurs Knowl* 2021; 32 (1): 59–67.
33. Swanson E, Mantovani VM, Wagner C, *et al*. NANDA-I, NOC, and NIC linkages to SARS-CoV-2 (COVID-19): part 2. Individual response. *Int J Nurs Knowl* 2021; 32 (1): 68–83.
34. Wagner CM, Swanson EA, Moorhead S, *et al*. NANDA-I, NOC, and NIC linkages to SARS-CoV-2 (COVID-19): part 3. Family response. *Int J Nurs Knowl* 2022; 33 (1): 5–17.
35. Park H. Identifying core NANDA-I nursing diagnoses, NIC interventions, NOC outcomes, and NNN linkages for heart failure. *Int J Nurs Knowl* 2014; 25 (1): 30–8.
36. Tastan S, Linch GCF, Keenan GM, *et al*. Evidence for the existing American Nurses Association-recognized standardized nursing terminologies: a systematic review. *Int J Nurs Stud* 2014; 51 (8): 1160–70.
37. Macieira TGR, Chianca TCM, Smith MB, *et al*. Secondary use of standardized nursing care data for advancing nursing science and practice: a systematic review. *J Am Med Inform Assoc* 2019; 26 (11): 1401–11.
38. Monsen KA, Martin KS, Christensen JR, Westra BL. Omaha system data: methods for research and program evaluation. *Stud Health Technol Inform* 2009; 146: 783–4.
39. Monsen KA, Austin RR, Goparaju B, *et al*. Exploring large community-and clinically-generated datasets to understand resilience

before and during the COVID-19 pandemic. *J Nurs Scholarsh* 2021; 53 (3): 262–9.

40. Fine S, Chaudhri A, Englebright J, *et al*. Nursing process, derived from the clinical care classification system components, as an earlier indicator of nursing care during a pandemic. *Int J Med Inform* 2023; 173: 104954.

41. Bose E, Maganti S, Bowles KH, *et al*. Machine learning methods for identifying critical data elements in nursing documentation. *Nurs Res* 2019; 68 (1): 65–72.

42. Monsen KA, Kelechi TJ, McRae ME, *et al*. Nursing theory, terminology, and big data: data-driven discovery of novel patterns in archival randomized clinical trial data. *Nurs Res* 2018; 67 (2): 122–32.

43. Monsen KA, Maganti S, Giaquinto RA, *et al*. Use of the Omaha System for ontology-based text mining to discover meaning within CaringBridge social media journals. *Kontakt* 2018; 20 (3): e210–e216.

44. Bjarnadottir R, Martin C, Maganti S, Hoffman M, Monsen KA. *Discovering the Value of the Omaha System for Knowledge Representation and Data Classification: A Semantics-Powered Text Mining Case Study*. SAGE Research Methods Cases; 2020. https://methods.sagepub.com/case/omaha-system-knowledge-representation-semantics-powered-text-mining.

45. Almasalha F, Xu D, Keenan GM, *et al*. Data mining nursing care plans of end-of-life patients: a study to improve healthcare decision making. *Int J Nurs Knowl* 2013; 24 (1): 15–24.

46. Stifter J, Yao Y, Lodhi MK, *et al*. Nurse continuity and hospital-acquired pressure ulcers: a comparative analysis using an electronic health record "big data" set. *Nurs Res* 2015; 64 (5): 361–71.

47. D'Agostino F, Vellone E, Cocchieri A, *et al*. Nursing diagnoses as predictors of hospital length of stay: a prospective observational study. *J Nurs Scholarsh* 2019; 51 (1): 96–105.

48. Sanson G, Welton J, Vellone E, *et al*. Enhancing the performance of predictive models for hospital mortality by adding nursing data. *Int J Med Inform* 2019; 125: 79–85.

49. Song J, Hobensack M, Bowles KH, *et al*. Clinical notes: an untapped opportunity for improving risk prediction for hospitalization and emergency department visit during home health care. *J Biomed Inform* 2022; 128: 104039.

50. Macieira TGR, Yao Y, Smith MB, *et al*. Nursing care for hospitalized older adults with and without cognitive impairment. *Nurs Res* 2020; 69 (2): 116–26.

51. Collins S, Couture B, Kang MJ, *et al*. Quantifying and visualizing nursing flowsheet documentation burden in acute and critical care. In: AMIA annual symposium proceedings. American Medical Informatics Association; 2018.

52. Monsen KA, Fitzsimmons LL, Lescenski BA, *et al*. A public health nursing informatics data-and-practice quality project. *Comput Inform Nurs* 2006; 24 (3): 152–8.

53. Monsen KA, Martin KS. Using an outcomes management program in a public health department. *Outcomes Manag* 2002; 6 (3): 120–4.

54. Monsen KA, Foster DL, Gomez T, *et al*. Evidence-based standardized care plans for use internationally to improve home care practice and population health. *Appl Clin Inform* 2011; 2 (3): 373–83.

55. Monsen KA, Swenson SM, Kerr MJ. The perceptions of public health nurses on using standardized care plans to translate evidence-based guidelines into family home visiting practice. *Kontakt* 2016; 18 (2): e75–e83.

56. Monsen KA, Swenson SM, Klotzbach L, *et al*. Empirical evaluation of the changes in public health nursing interventions after the implementation of an evidence-based family home visiting guideline. *Kontakt* 2017; 19 (2): e75–e85.

57. Bennett V, Southard ME, Monsen KA. Evaluation of evidence-based interventions for the nurse coach scope of practice within the omaha system guidelines corpus. *J Holist Nurs* 2022; 40 (3): 219–26.

58. Monsen K, Oftedahl G. Cardiac rehabilitation and informatics: strategies for increasing the global impact of cardiac rehabilitation on population health. *Turk Clin J Cardiol Special Topics* 2012; 2: 14–20.

59. Monsen KA, , Martinson B, Lawrence EC, *et al*. Toward population health literacy, wellbeing, consumer engagement, and information exchange: developing Omaha System icons for digital platforms. *Int J Healthcare* 2016; 2 (1): 71–81.

60. Monsen K, Heerman L, Dunn, Lopez K. FHIRE up! Advancingb knowledge for clinical data through application of standardized nursing terminology within HL7 FHIRE. *J Am Med Inform Assoc* 2023.

61. Muehlbauer M, Bradley C, Marquard J, *et al*. Clinical judgment and informatics: encoding simulations using the Omaha System. *J Nurs Educ* 2023; 62 (4): 237–9.

62. Kunkel DE, Tietze MF, Wilson M, *et al*. Creating case studies for digital health and technology competency in nursing. *Nurse Educ* 2023. doi: 10.1097/NNE.0000000000001458.

63. American Association of Colleges of Nursing. *AACN Essentials: Core competencies for Professional Nursing Education*; 2023. https://www.aacnnursing.org/essentials.

64. Keenan GM. Big data in health care: an urgent mandate to change nursing EHRs!. *Online J Nurs Inform* 2014; 18 (1).

65. Kang YJ, Monsen KA, Jeppesen B, *et al*. Interprofessional roles and collaborations to address COVID-19 pandemic challenges in nursing homes. *Interdiscip J Partnersh Stud* 2022; 9 (1): 7.

66. Huard RJC, Monsen KA. Standardized nursing terminology use in electronic health records in Minnesota. *Mod Clin Med Res J* 2017; 1: 13–9.

67. Matney S, Brewster PJ, Sward KA, *et al*. Philosophical approaches to the nursing informatics data-information-knowledge-wisdom framework. *ANS Adv Nurs Sci* 2011; 34 (1): 6–18.

68. Huling JD, Austin RR, Lu S-C, *et al*. Public health nurse tailored home visiting and parenting behavior for families at risk for referral to child welfare services, Colorado: 2018–2019. *Am J Public Health* 2022; 112 (S3): S306–S313.

69. Monsen KA. Trust, translation, and transparency in public health nurse family home visiting. *Am J Public Health* 2022; 112 (S3): S220–S221.

70. Kang Y, Mueller C, Gaugler J, Matthiason M, Monsen K. Toward ensuring care quality and safety across settings:examining time pressure in a nursing home with observational time-motion study metrics based on the Omaha System. *J Am Med Inform Assoc* 2023.

71. Cummins M, Hardiker N, Wang J, *et al*. American Academy of Nursing on policy social determinants of health: data standardization in electronic health records. *Nurs Outlook* 2022; 70 (3): 528–34.

72. Monsen KA, Rudenick JM, Kapinos N, *et al*. Documentation of social determinants in electronic health records with and without standardized terminologies: a comparative study. *Proc Singapore Healthc* 2019; 28 (1): 39–47.

73. Monsen KA, Austin RR, Jones RC, *et al*. Incorporating a whole-person perspective in consumer-generated data: social determinants, resilience, and hidden patterns. *CIN Comput Inform Nurs* 2021; 39 (8): 402–10.

74. Lu S-C, Mathiason MA, Monsen KA. Frailty and social and behavioral determinants of health: algorithm refinement and pattern validation. *J Gerontol Nurs* 2022; 48 (4): 41–8.

75. Holt JM, Austin RR, Atadja R, *et al*. Comparison of SIREN social needs screening tools and Simplified Omaha System Terms: informing an informatics approach to social determinants of health assessments. *J Am Med Inform Assoc* 2023; ocad092.

76. Wagner CM, Jensen GA, Lopes CT, *et al*. Removing the roadblocks to promoting health equity: finding the social determinants of health addressed in standardized nursing classifications. *J Am Med Inform Assoc* 2023; ocad098.

77. Ab Rahman A, Hamid UZA, Chin TA. Emerging technologies with disruptive effects: a review. *Perintis eJournal* 2017; 7 (2): 111–28.

78. Austria D. *Toward Automated Comprehensive Holistic Nursing Assessment: Sensor Technology, Standardized Data, and the*

Omaha System. Unpublished Doctorate in Nursing Practice Paper, University of Minnesota; 2020.

79. Thompson CW, Monsen KA, Wanamaker K, *et al*. Using the Omaha System as a framework to demonstrate the value of nurse managed wellness center services for vulnerable populations. *J Community Health Nurs* 2012; 29 (1): 1–11.

80. O'Neill AM, Mossing MR, Newcome MD, *et al*. Developing structured Omaha System goals for use in an electronic health record. *CIN Comput Inform Nurs* 2019; 37 (12): 655–61.

81. Aktas E, Esin MN, Monsen KA. Describing occupational health nursing interventions and outcomes in hair stylist apprentices with hand eczema using the Omaha System as a framework. *J Dermatol Nurs Assoc* 2022; 14 (2): 67–75.

82. Jurkovich MW, Ophaug M, Salberg S, *et al*. Investigation of the Omaha System for dentistry. *Appl Clin Inform* 2014; 5 (2): 491–502.

83. Kaya S, Secginli S, Olsen JM. An investigation of physical activity among adults in Turkey using the Omaha System. *Public Health Nurs* 2020; 37 (2): 188–97.

84. Vatani H, Sharma H, Azhar K, *et al*. Required data elements for interprofessional rounds through the lens of multiple professions. *J Interprof Care* 2020: 1–7. doi: 10.1080/13561820.2020.1832447.

85. SNOMED International. *SNOMED Interanational—Leading Healthcare Terminology Worldwide*; 2023.

86. Regenstrief Insitute. *LOINC from Regenstrief*; 2023. https://loinc.org/.

87. Monsen KA, Finn RS, Fleming TE, Garner EJ, LaValla AJ, Riemer JG. Rigor in electronic health record knowledge representation: lessons learned from a SNOMED CT clinical content encoding exercise. *Informatics for Health and Social Care* 2016; 41 (2): 97–111.