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Measuring Nursing Value From the Electronic Health Record

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Abstract. We report the findings of a big data nursing value expert group made up of 14 members of the nursing informatics, leadership, academic and research communities within the United States tasked with 1. Defining nursing value, 2. Developing a common data model and metrics for nursing care value, and 3. Developing nursing business intelligence tools using the nursing value data set. This work is a component of the Big Data and Nursing Knowledge Development conference series sponsored by the University Of Minnesota School Of Nursing. The panel met by conference calls for fourteen 1.5 hour sessions for a total of 21 total hours of interaction from August 2014 through May 2015. Primary deliverables from the bit data expert group were: development and publication of definitions and metrics for nursing value; construction of a common data model to extract key data from electronic health records; and measures of nursing costs and finance to provide a basis for developing nursing business intelligence and analysis systems.

Keywords. Common Data Model; Nursing Value; Nursing Business Intelligence and Analytics; Big Data

1. Introduction

The search for a method to measure nursing care value has been elusive. One main barrier is the lack of a comprehensive framework for defining value-based metrics and the lack of analytic approaches for measuring the economic, clinical, and operational outcomes of nursing care. Nursing care time (intensity) and cost measurement in the U.S. are typically averaged across many nurses and many patients and billed as a daily room charge [1]. Clinical data collected and used for patient care remains largely unused. With the emergence of electronic health records (EHR), there is an opportunity to consider and develop methods to extract relevant data to describe and analyze nursing care in ways that have not been possible to date.

1.1. Nursing Big Data Conference Series

In June, 2013 the first of a series of conferences to address big data in nursing was convened at the University of Minnesota School of Nursing [2]. The conference was an

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effort to address the exploding amount of data collected in healthcare and find ways to share and compare information and knowledge about nursing care within and across different settings. At the second conference in June 2014, several themes emerged from participants and ten big data expert groups were created to address core issues and concepts [3]. One focus area was the need to identify and measure the value of nursing care. An expert group was formed to address ways to extract key data from EHRs to measure nursing value and report findings back at the June 2015 conference.

2. Methods

2.1. Expert Panel Process

The big data expert group 7: measuring the value of nursing was formed at the 2014 Big Data in Nursing Conference as part of an overall action plan to investigate new methods to share and compare nursing and related healthcare data across differing settings, patient populations, and EHR systems [4].

The group consisted of 14 members from a diverse nursing background including clinical, informatics, leadership, academics, and professional organizations. Bi-monthly conference calls of 1.5 hours each were conducted from August 2014 through May 2015 for a total of 14 sessions and 21 hours of group interaction time with an average participation of 55.1% across the sessions. Guests from professional organizations participated in several calls to provide background to the group as needed.

2.2. Goals of the Big Data Expert Group: Measuring the Value of Nursing

Goals for the expert panel were established on the first convening session in August 2014 and included the following:

1. Develop a national consensus data model to measure patient level nursing intensity, patient level outcomes, and costs per patient in multiple care settings to support the continuum of care and to produce objective measures of nursing value.
2. Develop new nursing business intelligence and analytic tools that will utilize the rich clinical, operational, financial, and quality/safety outcome data currently available to measure and compare nursing value.
3. Develop and test new nursing financial models to bring transparency to support the risk sharing within Accountable Care Organizations (ACO), Value Based Purchasing, and pay for performance models.

3. Results

To meet the first goal of the expert panel, several sessions were needed to define nursing value. One key idea emerged and a consensus was formed that nursing care is provided by individual nurses who act as unique providers of care and the primary focus of measuring nursing care was the encounter between a single nurse and patient, family or community [5]. This drove the construction of the data model to define, within the data, a way to link each nurse with each patient (Figure 1). There are several

analysis possibilities using this approach, for example patient level nursing costs can be derived from an aggregate of individual nurse and patient encounters such as an inpatient assignment or home visit. Patient problems, nursing interventions, and care outcomes can be included and linked to patients, nurses, or setting specific variables. For example, the Nursing Outcomes Classification (NOC) [6] data can be collected sequentially throughout a hospitalization and linked to nurse staffing and assignment patterns to determine whether unit or nurse level factors such as high workload or low experience is associated with the clinical trajectory.

3.1. Common Data Model

The common data model in Figure 1 is designed to be vendor agnostic and setting neutral. The primary purpose is to provide a framework for data extraction from different EHRs to compare and benchmark nursing care across many settings. The components of the common data model allow collection of individual patient, nurse, and facility data with linkages by primary and secondary keys to facilitate abstraction. The intent is to build a robust data model that will allow development of new analytic methods and future business intelligence tools that can identify patient level nursing costs, quality, performance, productivity, efficiency, and effectiveness [7].

3.2. Big Data Analytics and Nursing Business Intelligence

Value-based metrics were discussed and chosen based on the goals of the group and suitability and fit with the common data model (Table 1). These core metrics form the basis for developing new analytic techniques that can provide near real-time feedback to clinicians and managers. The metrics can be used to develop new nursing business intelligence tools to provide aggregate and summary data on the clinical care as well as quality outcomes, operational workflow and cost of nursing care. The ability to identify unique nurses caring for individual patients provides a new capability to identify patterns and trends at the nurse-patient unit of analysis. Some potential analysis include measuring exact nursing care hours and costs for each patient summarized by a complete episode of care (hospitalization) or effects of difference levels of staffing, skill mix (such as unlicensed versus professional staff), and experience on outcomes of care.

Table 1. Nursing Care Value Metrics

Metric	Traditional Model	Value-Based Model
Staffing Levels	Unit level analysis of hours and costs by skill mix, e.g. %RN vs UAP	Patient level analysis of direct care hours by nursing skill mix, effects of individual nurse and nurse characteristics (e.g. experience level or AD vs BSN) on patient outcomes of care
Outcomes	Hospital and unit level outcomes, e.g. average length of stay	Patient level outcomes analysis e.g. unit and hospital length of stay adjusted by nursing acuity or tied to DRG/DX, change in shift level nursing outcomes.
Trending	Trend of unit average cost per patient day by month or quarter	Trend of patient level direct costs per patient day (direct) by month, day of stay, DRG, etc.

Nursing Costs	Average total nursing costs per patient day (many patients and many nurses)	Patient level nursing costs per day per patient; nursing wage variability by patient;
Nursing Acuity	Unit level average metrics by month or quarter	Patient level acuity by day of stay, aggregate metrics by shift, month, day/evening, quarter, etc. As well as patient level acuity trends (patient) or aggregate unit level trending analysis. Patient level acuity by discharge or DRG
Nurse Characteristics	Unit or department level average nurse experience and academic preparation by budget period (e.g. month, quarter)	Patient level measures of average experience level and academic preparation of nurses assigned to patient aggregated by day of stay, summary for hospitalization, trend by shift, etc. These can be rolled up into an episode of care, e.g. hospitalization, series of home visits, etc.
Workload	Nurse to patient ratios or average NHPPD	Acuity adjusted assignments and efficiency measures, e.g. relationship between actual patient level hours needed vs. delivered

4. Discussion

The findings of the big data nursing value expert group provide a basis for developing new business intelligence and analysis tools using existing and emerging real-time clinical and operational data. The primary purpose of this work is to disseminate a common way to extract these data from existing EHRs and develop new metrics that can identify nursing care system effects as well as individual nurse effects on patient outcomes. Future work will involve testing the model with live clinical and operational data as well as incorporating the common data model into existing EHRs.

5. References

[1] J.D. Thompson, D. Diers, *Nursing resources*, in: R.B. Fetter, D.F. Brand, D. Gamache (Eds.) DRGs. Their Design and Development, Health Administration Press, Ann Arbor, 1991, pp. 121-183.
[2] C. Delaney, B.L. Westra, Capturing Nursing Information for Big Data Research and Improved Health Outcomes, Proceedings of the Conference: Nursing Knowledge: Big Data Research for Transforming Health Care. August 12-13, 2013, University of Minnesota School of Nursing Center for Nursing Informatics, Minneapolis, MN, August 12-13, 2013, 2013.
[3] C. Delaney, B.L. Westra, Proceedings of the Conference: Nursing Knowledge: Big Data and Science for Transforming Health Care, University of Minnesota School of Nursing, Minneapolis, MN, 2014.
[4] T.R. Clancy, K.H. Bowles, L. Gelinas, I. Androwich, C. Delaney, S. Matney, J. Sensmeier, J. Warren, J. Welton, B. Westra, A call to action: Engage in big data science, *Nursing Outlook*, **62** (2014) 64-65.
[5] J.M. Welton, E.J. Harper, Nursing Care Value-Based Financial Models, *Nurs Econ*, **33** (2015) 14-20.
[6] S.E. Birmingham, K. Nell, N. Abe, *Determining Staffing Needs Based on Patient Outcomes Versus Nursing Interventions*, in: P.S. Cowen, S. Moorhead (Eds.) Current Issues in Nursing, Mosby, St. Louis, MO, 2010, pp. 391-404.
[7] J.M. Welton, Nursing and the Value Proposition: How information can help transform the healthcare system, in: B.L. Westra, C. Delaney (Eds.) Proceedings of the Conference: Nursing Knowledge: Big

Data Research for Transforming Health Care. August 12-13, 2013, University of Minnesota, School of Nursing, Center for Nursing Informatics, Minneapolis, MN, August 12-13, 2013.

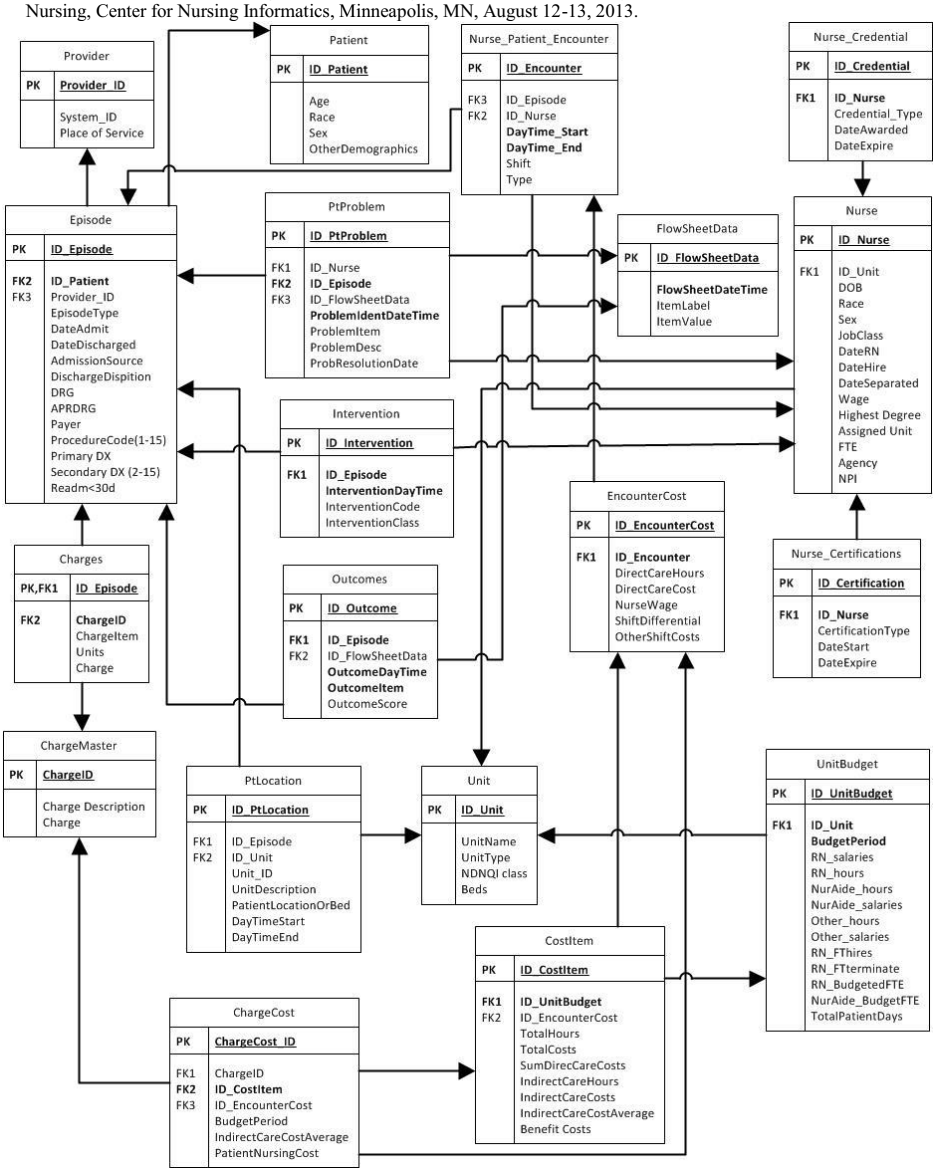

Figure 1. Nursing Value Common Data Model.