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Supporting Nursing Services through a Research Framework and Reference Model

Keith Toh[1], Liza Heslop[2], Trish Burton[2]

[1]Centre for Governance, Work and Technologies, RMIT University, Melbourne, Australia
[2]School for Nursing and Midwifery, Centre for Applied Informatics, Victoria University, Melbourne, Australia

Abstract

Nursing services represent a large part of health service resources that trigger health care costs and in-comes. Conservative estimates suggest that nurses represent 30% of total hospital expenditures without in-vestments. Currently, clinical nursing knowledge management is not supported by the most appropriate supportive business and technical solutions. Improvement to nursing services, through collaborative research activity that engages both academics and clinicians, should be underpinned by a conceptual framework to facilitate knowledge capture and sharing. We propose a nursing services research framework to guide and improve the delivery of nursing services to achieve a sustainable health system. The framework supports development of interdisciplinary research and development activities through clinical and academic partner-ships.

Keywords: Nursing Services Improvement; Business Architecture; Research Framework

1 Introduction

The following excerpt has been extracted from the www site of the Royal College of Nursing, UK, and illustrates that, even today, the concept of nursing services may not be properly and appropriately communicated.

"*All nurses carry in their heads a personal concept of nursing – what it is, what it is for, and how we do it. The problem, at least in the UK, is that this concept is rarely put into words, and until it is, it cannot be communicated to other people. We do not know, therefore, whether all nurses share a common concept, let alone share it with patients and the public. It is part of the social mandate of a profession to make clear to the public the nature of the service it offers, and to ensure the quality of its service through mechanisms such as professional regulation*" [1].

The excerpt shows that leaders of the nursing profession, at least in the UK, have identified the need to clarify the concept of nursing service to enhance public understanding about nursing and to improve nursing care quality.

When clinicians and academics work collaboratively to build foundational activity for the conduct of projects to improve nursing services, they are faced with many challenges. These challenges may include high costs, slow results, lack of funding, regulatory burdens, fragmented infrastructure, incompatible databases and shortage of qualified investigators and willing participants [2].

Nursing services improvement research frameworks are not only needed to support such challenges but are important for other purposes:

- To develop inter-organizational relationship (organisational aspects of political, cultural, and professional factors);

- To build interactive research projects;
- To allow for better understanding of the partners' needs;
- To assist with allocation of time and resources across partners;
- To serve as a leadership tool for researchers and health service managers.

Without a sound conceptual framework to underpin a nursing services improvement strategy, poor deployment of business processes and information communication technology may occur [3]. The flow on effect for interprofessional team efforts is that evidence-based care may not transfer to interprofessional bases of practice. Thus, when research is conducted by a single professional group, research outcomes are poorly considered for their impact on other professional groups, resulting in less than optimal health outcomes [4].

There are many dimensions of the nurse practice environment that can benefit from the adaptation of conceptual frameworks that are currently in commercial use. One dimension, pivotal to this paper, concerns a nursing research development priority to build collaborative research [5]. Collaborations and partnerships should ideally be underpinned by a clearly articulated research program and supported by a conceptual framework that serves the purposes of leading and guiding group efforts towards common goals. The goals of collaborative research can then more properly focus on improving tangible care delivery outcomes that are accounted in hospital expenditure.

Nurses must increasingly deal with information and share their information with multi-disciplinary teams. Nurses at the frontline are confronted with questions of how best to use evidence-based research in practice and with collaborative research teams to improve healthcare outcomes. These questions require a research framework to link evidence-based practice with health outcomes. The aim of this position paper is to present a research framework to guide and improve nursing services. The context of our position paper and the framework and the reference model is acute health services and hospital ward based nursing practice. From now on in this position paper, we will refer to this context as the Nurse Practice Environment (NPE).

2 Building a Framework for Collaborative Research in Health: The Influence of E-Government and ICT Frameworks

Australia is moving towards adopting electronic health records (EHR). The successful implementation and use of EHR's is entirely dependent upon the digitalization, structure, storage and retrieval of information in a timely manner. Information drawn from the EHR, when combined with existing clinical knowledge, can create new knowledge needed to plan and implement the right care and treatment protocols for individual patients.

The nursing improvement research framework, outlined in this paper, was developed by a committed interprofessional team with expertise and established networks in the field of Nursing Science, Computer Science, Health Knowledge Management and Health Informatics. The technologies and business architectures found in e-business and e-government are mature and have potential to benefit the development of a collaborative research framework for nursing services. The fields of Enterprise Modelling (EM) and Enterprise Architecture (EA) play, also, an important role. Enterprise modelling delivers the EA or "blueprints" for organisations and their information systems. The role of Enterprise Architecture Frameworks, their common features and a guide for their selection may be found in Schekkerman [6]. Examples of EA are The Open Group Architecture Framework [7], Department of Defence Architecture Framework [8], Australian Government Architecture [9] and the Zachman Framework [10]. An overview of EA concepts, such as collaborative business architectures, technology platforms and standards for data exchange, which have influenced the development of the nursing improvement research framework are now provided.

E-government is a way for governments to use new technologies to provide people with more convenient access to government information and services [11]. Kung [12] examined three perspectives of Web application evolution, namely applications, processes, and services, to illustrate how application evolution dynamics impact upon the interplay of each perspective. Ho [13], on the other hand, describes the development of information technology (IT) and e-Government projects of the Hong Kong Special Administrative Region Government. And Weerakkody [14] used case studies in three European countries to explore process and system integration challenges in the European public sector in the context of e-government implementation. Finally, Stojanovic [15] describe the use of semantic

technologies for describing e-government services to improve change management. Of interest to e-government is the Business Process Interoperability Framework (BPIF) that provides a guide and tools to assist agencies to make the transition to connect and share modes of operation [9].

3 Overview of the Nursing Services Research Framework

The components of the Nursing Services Improvement Framework (Figure 1) for the NPE comprise:

a) Overarching Nursing Services Ontology

b) Nursing Services Data Model

   a. Minimal Data Set

   b. Archetype development (see Clinical Knowledge Manager www.openehr.org/knowledge) or Ocean informatics (www.oceaninformatics.com) websites to assist with explanation of archetypes.

   c. Standardisation of clinical data formats and terminologies and streamlining multi-disciplinary care management

c) Nursing Services Business Architecture

   a. Nursing Services Reference Model (NSRM)

   b. Nursing Services Strategy Map

   c. Business Improvement Framework

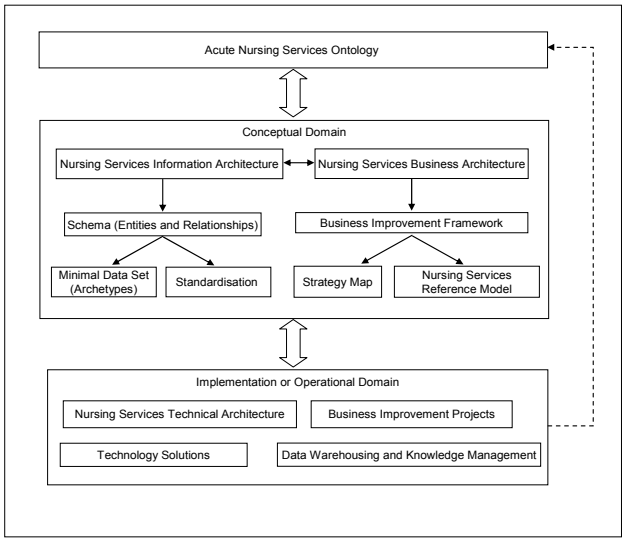

Figure 1: Nursing Services Research Framework

The nursing services research framework is an organising view for identifying the different components targeted for improvement and provides, also, the conceptual relationships or "linkages" for the inter-related components. The framework is divided in terms of the conceptual and operational view. The former may be seen as the pertinent to the design or research time domain, and the latter is in the operational domain.

The nursing services research framework separates business and technology architectures. Commercial enterprises in the global environment have well developed research and development frameworks, which are emulated through concepts of business and technology architectures. Yusuf [16] outlined three levels of cooperation among enterprises culminating in a virtual partnership. In addition, Tuma [17] establishes a distinct form of network organisation with a high degree of organizational flexibility to provide a "best of everything organisation" by combining core competencies of single partners (centres of competence) in order to perform a given business project to achieve maximum degree of customer satisfaction.

The nursing services research framework is based upon the concept of a collaborative and open environment. Globally, independent companies work together on shared values and common goals for doing business and for joint exploitation of business opportunities [18]. In Australia, the application of frameworks with business and technology architectures to support research and development activity is poorly considered in the context of nursing research. While much attention has been given to the development of commercial business architectures and strategies, there is a conspicuous absence of equivalent research effort in the area of acute nursing services - a critical sector in health care. Still, commercial business and technology architectures should be tailored for nursing research and development rather than their entire direct import. Careful consideration of architectural concepts such as "value proposition" and "branding" may be commercially ubiquitous but may not directly translate to business concepts for nursing services. The application of commercial business service architectures to the NPE frontline is likely to result in the representation of acute nursing service delivery, where the definition of "customers" need to take into account significant others and family members of the patient.

There are many other aspects of the framework, such as application architecture, platforms, network architecture, security architecture which remain outside the scope of the framework. In keeping with architectural practice, we have separated the conceptual framework from the implementation technology. Though relationships exist between conceptual

and an implementation domain, our framework protects the conceptual domain from implementation issues which tend to be technology specific. Some aspects of health technology solutions e.g. Radio Frequency Identification (RFID) are mature and provide opportunities to explore how nursing services may benefit from exploitation of the technology.

At the top of the Figure 1 lies the overarching concept of nursing ontology. Ontology concerns overarching structures of high level nursing data entities and relationships. Textual or graphical information exchanged in nursing services to support patient need to be captured, stored, retrieved, processed and viewed and to do this the information should be managed consistently and preferably underpinned by a set of standards to support information exchange. Clinical terminology standards form part of ontology. Standardization of information structures and interoperability or the ability of systems to share and interpret information in a meaningful way also form part of ontology research [19].

Some research examples that concern nursing ontology include the specification and use of data standards. An emerging area of ontology research relates to the standardization of nursing documents. For example, the HL7 Clinical Document Architecture standards for the eNursing Summary – a discharge and transfer document which incorporates several internationally accepted concepts such as the ISO 18104 Reference Model Terminology for Nursing [20]. National structures of nursing documentation are also supported by research in Finland where one collective structure and model for nursing documentation is based on national guidelines [21].

Most nursing systems research activity must be cognizant of nursing ontology and internationally accepted terminologies for the nursing domain of knowledge, which are largely being undertaken by international nursing standards organizations. The use of concepts from unified and standardized terminologies support data quality, information exchange and decision support. The ICNP Version 1 is a unified nursing language that facilitates the development of and the cross-mapping of local terms and existing terminologies and recent research mapped the ICNP Version 1 concepts to SNOMED CT to promote unification and standardisation of terminologies [22].

For partnership research with national implications, research activity and development must incorporate understandings of ontology. Integration with, and adoption of, international standards has many benefits. These include: enhanced international trade via software developers and suppliers; enhanced international linkages for academics, members of professions and health care funders through collaborative international research into nursing service delivery and its effectiveness; benefits for health care funders who seek less costly health service system connectivity and maintenance; benefits for consumers via improved targeted nursing services and increased patient safety and decreased adverse events; and benefits for nursing workforce planners in terms of their ability to assess national and international trends for the demand of nursing services.

There is much scope for nursing research development at the level of ontology. For example, there is no concerted development in Australia to enhance nursing content and activity within data structures that allow for effective digital nursing data flow. Data structures include hierarchies and categories of knowledge for a specific domain, such as nursing practice. Such structures are supported by a reference model. This research work needs to be addressed by the profession at a national level.

4 Development of Conceptual Domains for Nursing Services Improvement

Referring back to Figure 1, we have expanded the conceptual domain of the nursing services improvement framework into two areas - Nursing Services Information Architecture and the Nursing Services Business Architecture.

Within the domain of Nursing Services Information Architecture (Figure 1), systemic change is necessary to accommodate the content of nursing records within information systems to fulfil interdisciplinary needs. Interdisciplinary professionals must access nursing files and records daily to make decisions about patient care. Such access would be greatly improved if the records and files were available in computer processable format. Effective digital nursing data flow within and between healthcare agencies enables the use of these data both as contributions to electronic patient records and for the purpose of managing nursing workflow efficiency, nursing workload allocation, costing, and effective nursing service and performance management.

4.1 Nursing Services Reference Model (NSRM) or Architecture

An area of research which fits within the Business

Improvement Framework specified in Figure 1 is the foundational development of a Nursing Services Reference Model [23]. For the Business Improvement Framework domain of Figure 1, one of the most pressing problems faced by the health care industry is that the content of nursing practice is not embedded in health system information structures. Given the importance of the nursing domain of care, the lack of a reference model at a national level that links with AGA architectures has a major impact on research and development of health service systems [23]. A notable omission, however, is the absence of a nursing services reference model in the AGIMO standard and this represents a significant opportunity for multi-disciplinary research.

The lack of an agreed upon NSRM, including a lack of reference data structures for nursing services and the adoption of nursing language, impacts upon many aspects of nursing services such as cost, efficiency of workflow and nursing service delivery, allocation of workload, and workforce projection. Efforts to define nursing information requirements, redesign activity flow and to identify performance indicators are bottom up approaches that remain problematic as a service description for nursing is lacking.

In section 4.2, we describe a first draft of the NSRM that we are researching to prove value in the model so that it may eventually form the basis of a common language between stakeholders. The NSRM structures a repository of architectural artefacts. It provides a functional view of common business areas associated with the delivery of acute hospital nursing services that are independent of who performs the work of the business areas. In simple terms, it provides a structure for consistently categorising and organising data, information and knowledge to optimise automation and computer processing. The NSRM, when developed, would support achievement of strategic goals if incorporated into business focused enterprise architectures and the management processes of acute hospitals. The NSRM is structured into a tiered hierarchy representing the nursing service business functions of acute hospitals.

4.2 Business Functions Associated with Hospital Nursing Service Delivery

A business driven, functional framework reflects an industry wide agreed classification of service components with respect to how they support the business and meet business objectives. It serves to identify and classify service components that support a hospital's agreed business operations. The model helps to build and recommend service capabilities to support re-use of business components and services across the health industry. The NSRM is constructed hierarchically and across horizontal service areas independent of business functions. It can provide a foundation for sharing and reuse of software applications, application capabilities, components and business services. The NSRM is structured around service domains, types and components.

The NSRM service domains provide a high-level view of the services and capabilities that support enterprise wide organisational processes and applications. They are differentiated by their business-oriented capability. Service domains are comprised of service types that further categorise and define the capabilities of each domain.

Service types group similar capabilities in support of the domain by providing an additional layer of categorisation that defines the business context of a specific component within a given domain. Each Service type includes one or more service components that provide the building blocks to deliver the Component capability to the business. Note that many service types are associated with multiple domains. From an ontological and database design perspective, it is necessary to break down and organise these concepts in a manner that avoids many-to-many relationships.

Service components are self-contained business processes or services with predetermined functionality that may be exposed through a business or technology interface. Service types and components are numbered in a sequential manner that does not describe a structure within the model. Nursing service business components related to each service could be described as specific functions or tasks such documentation, as well as descriptions of relationships such as for medication management for example one key relationship is medication supply.

Figure 2 (see appendix) lists business components at the highest level, the nursing service domains and service types. It is a prototype, which is still in the development phase.

The NSRM will provide a framework (Figure 3 - see Appendix) that:

- Explains and describes the how we manage the business of nursing service delivery from an enterprise wide perspective at various levels.
- Describes the nature and scope of the many services hospital nurses provide within a well defined

business context with reference to standards, protocols or best practices.

- Provides a common language for all stakeholders involved in the delivery of cross-agency services
- Supports the identification of duplicate, re-usable and sharable services
- Provides a basis for the objective review of ICT investment
- Enables more cost-effective and timely delivery of ICT and knowledge management services through a repository of standards, principles and templates assisting system architecture design and delivery of ICT support services to enhance the efficiency and effectiveness of nursing service delivery at the point of care.

The Nursing Strategy Map is identified in Figure 1 as a collateral component of the NSRM. Its development would provide a widely applicable template to support nursing services improvement at the ward level. Without this strategic map in the form of a standardized and adaptable template, business process improvement initiatives are likely to be "orphaned". The map defines a strategy to embed quality improvement initiatives in the realities of practice at the grass roots or ward level of nursing practice.

The development of research underpinned by the nursing services improvement framework will ascertain whether the nursing services sector is different from the business sector and the architectures that are widely applicable in commercial industries. Nursing researchers should comment on whether the importation of business architectures and methodologies, such as strategy maps are applicable to the improvement of nursing services within the NPE.

5 Conclusion

There are many challenges concerning health service systems – their problems of safety, quality, failure to maximise value and failure to make use of preventative health. There are new health system challenges too – growing social inequalities, financial and carbon. This paper has outlined the acute health nursing services improvement framework to support, guide and improve nursing services.

The proposed nursing services research framework underpins a nursing services improvement program to optimise links between clinical knowledge, business processes and computing technologies. The objectives of the nursing services research framework include:

1. Promoting inter-disciplinary participation in the Nursing Services Research Program
2. Improving the research strengths of the university
3. Adopting and enacting a Research Framework for Health Data Management
4. Promoting cross-university collaboration
5. Extending the research capacity to become self-sustainable
6. Contributing to generation of new knowledge

Implementation of the nursing services research framework will add value to the health system in two ways: help nursing workers to do the right thing (making the right decisions); and support them to do things right (quality improvement). It guides and supports opportunities for partners to adapt and employ state of the art techniques and methodologies from health knowledge management science, computational and engineering sciences to develop appropriate theoretical and technical solutions to communicate nursing business and clinical information effectively, both within, and across health system structures.

The nursing services research framework allows for a collaborative and partnership approach as it represents a tool to build trust and commitment. It facilitates clear roles and expectations. Its use will secure organisational rather than individual support.

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Correspondence

Assoc. Prof. Liza Heslop

School of Nursing and Midwifery
Victoria University
PO Box 14428
Melbourne Victoria Australia 8001
Telephone: +61 3 99192252

Appendix

Figure 2: Prototype of Nursing Services Reference Model (NSRM)

Business	High Level Nursing Service Type & Service Domains	Service types
Nursing services for patients at point of care Patient care services, clinical processes (Professional Nursing Services)	Operating Room Emergency Department Outpatient nursing Pathology Nursing Imaging nursing Ward nursing	Medication management Medication reconciliation (checking, administering) Immunization management Blood administration Data exchange across acute and ambulatory settings Order communication Results reporting Intravenous management Intake/Output management Case management Transfer of accountability of care Vital signs Specimen collection Problem list management Wound management Restraint use Bowel management Pain management Family / significant other engagement Identifying patient/family expectations End of life – ethical decision making Haemodynamic monitoring Mobility management Hygiene management Triage Surgical team service (scrub, scout, recovery) Diagnostic support service Ward service delivery model Consulting support service
Mechanisms used: Nursing administrative /management services within a ward or department	Clinical management Quality & safety management Outcomes management Nurse staffing management Care handover/discharge instructions	Intraprofessional clinical rounds Bed management Nurse roster management Case management Patient acuity and classification Admission, discharge, and transfer process Allergy management
Necessary support functions: Organisational & operational support service delivery	Knowledge management Information services Systems management Organisation bed allocation management Catering Security services Tracking and workflow Service scheduling Patient complaints/incident reporting Casemix/patient acuity management Infection control services Patient relations services Patient transport services Telehealth/telemetrics Critical response services	Clinical knowledge management (practice guidelines, procedures, clinical models, terminology, mapping, information retrieval, data mining, modelling) Document management (EHR, forms, administration records, patient records, indexing, document conversion/storage) Master copy, version control management Information management (email, letters, meetings, referrals, social networking, patient education) Data collection & reporting Publishing/website content management Visualisation (data conversion)

Resource management functions, corporate services	Management/governance services Financial management Business analytical services Clinical governance Quality management Research & practice evaluation HR services Change management Project management Development & integration Investment management (capital works) Equipment and supplies management (supply chain) Multi-lingual support services	Organisational nurse allocation management Determination of appropriate skill mix Continuing professional education (on site lectures, online short courses, workshops, tutorials, staff orientation) Certification record keeping Reporting Online help/technical support Interpreter services

Figure 3: Acute Care Nursing Services Reference Model