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DISCUSSION PAPER

Instantiating informatics in nursing practice for integrated patient centred holistic models of care: a discussion paper

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Abstract

Aim. To discussion on how informatics knowledge and competencies can enable nursing to instantiate transition to integrated models of care.

Background. Costs of traditional models of care are no longer sustainable consequent to the spiralling incidence and costs of chronic illness. The international community looks towards technology-enabled solutions to support a shift towards integrated patient-centred models of care.

Design. Discussion paper.

Data sources. A search of the literature was performed dating from 2000–2015 and a purposeful data sample based on relevance to building the discussion was included.

Discussion. The holistic perspective of nursing knowledge can support and advance integrated healthcare models. Informatics skills are key for the profession to play a leadership role in design, implementation and operation of next generation health care. However, evidence suggests that nursing engagement with informatics strategic development for healthcare provision is currently variable.

Implications for nursing. A statistically significant need exists to progress health care towards integrated models of care. Strategic and tactical plans that are robustly pragmatic with nursing insights and expertise are an essential component to achieve effective healthcare provision. To avoid exclusion in the discourse dominated by management and technology experts, nursing leaders must develop and actively promote the advancement of nursing informatics skills. For knowledge in nursing practice to flourish in contemporary health care, nurse leaders will need to incorporate informatics for optimal translation and interpretation.

Conclusion. Defined nursing leadership roles informed by informatics are essential to generate concrete solutions sustaining nursing practice in integrated care models.

Keywords: advanced practice, informatics, nursing, nursing leadership, policy, professional development

Why is this review needed?

- Health care is in transition globally and traditional models of care are no longer seen as economically viable or fit for purpose. New models of care delivery are falling short on impact, particularly with regard to the anticipated benefits at the clinical interface and calls for integrated care models are escalating.
- The holistic perspective of nursing knowledge and nurses' contributions across the continuum of care are essential to further inform and advance the development of integrated healthcare models.
- Informatics can assist the profession to play a key role in design, implementation, uptake and use of next generation healthcare models. Nurse leaders must recognize and develop essential informatics skills to remain relevant and effective in current and future healthcare transformation.

What are the key findings?

- This novel discussion paper outlines the emerging topic of how the profession of nursing can contribute to health service delivery transformation using informatics as a vehicle for change.
- It presents examples of the role that nursing provides in evolving care delivery and distinguishes both change and transition as two distinct processes for optimum impact on patient outcome.
- It provokes nurse leaders to consider the imperative of developing informatics skills as a mechanism to position nursing in healthcare system transformation and for the nursing profession to remain engaged as other healthcare professions rapidly strengthen informatics expertise and sophistication in leadership roles.

How should the findings be used to influence policy/practice?

- Recognition of nurse leaders' valuable contributions must be more explicitly and assertively promoted to maximize opportunities for progressive and proactive engagement.
- Inclusion and visibility of nursing on strategic policy and practice agendas in inter-professional care delivery models will ensure pragmatic approaches are embedded for holistic and integrated care.
- Structured opportunities to develop nursing informatics knowledge and skills must be recognized and developed as critical enablers to sustain the competency and relevance of contemporary nursing practice and leadership.

Introduction

The degree and pace of change in the digital age has ushered in not only advances but also challenges to the existing organization and practice of established healthcare models. State of the art policy and action plans are increasingly reframing models of care and in particular, the manner in which health care can be delivered (Rigby 2014). Models of care are maturing to become decidedly patient-centric and patients are increasingly perceived both as service users and active participants in care planning and management, thus departing from the traditional view of the role of the patient as a passive recipient of care. Despite the advancing capacity of technology to deliver applications to enhance citizens' well-being (Doyle & Walsh 2014), there is still much progress to be made on effective integration of technology at the service delivery level (Adler-Milstein & Bates 2010, Abramson *et al.* 2012). For many citizens, the existing hospital-centrism and hyper specialism continue to prevail despite the evolution of technological innovation in health care. Fragmentation of services, poor care co-ordination and a lack of access to critical information at the point of care delivery continue to impede the delivery of affordable, accessible and equitable health care (Agency for Healthcare Research & Quality (AHRQ) 2014, McEvoy 2014).

The World Health Organization (WHO 2015) provides insight into how integrated models of care are maturing globally with a recently published Interim Report on patient-centred integrated care services, providing evidence with contextual examples on how different countries are innovating nationally to facilitate integrated health service delivery. Detailing models of best practice and lessons learnt, this WHO report presents five strategic directions with specific approaches that can be used to achieve anticipated goals (WHO 2015).

A core principle underpinning integrated care is redesigning health and care delivery systems to align models more closely to population health and community well-being, while remaining sensitive to the needs of active service users. This requires focused attention, particularly in relation to empowering and engaging people across the continuum of care. Health leaders and policy makers are gradually recognizing that the redesign process is complex and multifaceted and to realize investment, the process requires thoughtful consideration (WHO 2005, Organization of Economic Co-Operative Development 2010, Pan American Health Organization 2012, eHealth Ireland 2013, National Health Service 2014, European Commission 2012, 2013, WHO 2015).

Nurses have engaged in informatics programs since the 1970′s although records of Florence Nightingale notes on transformation of health care date back to 1863 (Hussey *et al.* 2014, p. 56). Despite targeted nursing informatics (NI) innovation and adoption, nursing leaders have yet to

broadly embrace and develop informatics competencies that enable strategic advancement of the nursing profession in the increasingly technology dependent healthcare environment. Furthermore, research detailing a lack of NI programs (Oakes *et al.* 2015) suggests that transformation by current and future nursing leaders is in jeopardy. This gap in leadership skills and educational opportunities will continue to marginalize nursing based on an inability to initiate and lead informed discourse in complex, technology dependent healthcare environments.

This discussion paper considers the challenge of integrated healthcare models in the context of global health priorities and proposes that nursing as a profession can do more to influence global policy agendas. We examine the mechanisms though which nursing leaders engage in the healthcare transformation discourse and argue that nursing knowledge, via NI knowledge and skills, must be thoroughly embedded in healthcare system redesign to ensure that strategic plans supporting integrated health care are achieved in a sustainable manner. Included in these sections will be examples on how NI activity can be mapped to WHO strategic enablers including care delivery, data quality and education and use of informatics as a critical instigator for professional engagement in future healthcare service provision. Furthermore, we advocate that nursing leaders must initiate and advance specific discourse in the nursing profession on NI skill development and the dependency on NI to ensure that nursing remains relevant and engaged in healthcare evolution in the digital era.

Background

Global trends and the complexity of chronic disease

Global trends reflect a staggering shift in population age and non-communicable disease burden. Between 2000 and 2050, the proportion of persons over age 60 will double from approximately 11-22% and the number of individuals aged 80 and over will quadruple to 395 million by 2050 (WHO 2014). WHO also reports that the main health burdens for older persons are due to non-communicable diseases (WHO 2015) and the shift between acute and chronic health problems is generating new and unique demands on healthcare professionals. As the prevalence of global population of over 65-year olds continues to rise, the number of individuals described as having complex care needs requiring shared care also continues to increase (Nolte & Pitchford 2014). Such new demands will necessitate additional education and competency development not only for healthcare professionals (WHO 2015) but increasingly for carers and citizens on self-care management (National Health Service 2014). Over their extended time span, chronic diseases are likely to intensify, interfering with the individual's ability to function normally in society (disability), with the cumulative result of a perception of 'otherness' (stigma) (McEvoy 2014 p.7).

Traditional models of care, providing hyper-specialized, program-specific delivery to narrowly defined patient cohorts (e.g. cardiac programs, diabetes programs, etc.) are unable to support integrated complex needs in a manner that achieves optimal outcomes. The focus, therefore, needs to return to holistic treatment of the whole person, to be culturally and socially sensitive to individual needs and where appropriate to include individual, family group or community models of care (Rigby 2014). Personalized holistic health care, supporting all dimensions of client health is possible through innovation of care models, technological innovation and active engagement by all healthcare stakeholders.

Locating nursing models of care in global policy agenda for integrated care

Models of care in nursing which are relevant to this policy debate can be described as abstract theories, which use general measures to present a reference framework for advancement of nursing practice. Examples of nursing framework models include the Activities of Daily Living Model (Roper *et al.* 1990) or Self Care Model (Orem 1991). Data collected from such models in the past have been used to test theories and assist in the development and validation of contemporary nursing knowledge and skills. In the midst of the transformation to integrated holistic care, nursing leaders are required to advance practice while providing essential information for data analytics supporting efficient and effective service delivery.

As well as articulating the profession's contribution to patient care through a formalized framework for guiding education and practice, nursing models of care provide a model of reality which aligns well with the integrated care agenda. This is particularly important for contemporary healthcare service provision, where 'big data', also referred to as 'data analytics' and 'data science', is recognized as providing unprecedented opportunities to advance more efficient interventions for health and social care provision (Brennan & Bakken 2015, Westra *et al.* 2015). Big data is characterized by volume, velocity, variety and more recently, veracity and is described as the field of information management and interpretation on data whose scale, diversity and complexity require new design techniques to extract value and hidden knowledge (Laney 2001, Harper

2014). Big data leverages data from increasingly diverse data sources and exposes complex patterns, often revealing new insights and knowledge. The sheer scale of analytics from various data sources presents new opportunities for practice theory development (Mayer-Schonberger & Cukier 2013, Brennan & Bakken 2015, Westra *et al.* 2015). Data derived through complex analytics are increasingly important as health care moves from retrospective analysis to greater predictive analysis as new insights into healthcare system efficiencies and evolution of models emerge.

Informatics as a specialist body of knowledge provides competencies for the nursing profession to develop new models of care. Informatics relates to integrating three knowledge domains, health, computer and information in the development of resources for health service provision (Ball & Hannah 1984). These three integrated domains act as a key driver informing the development of new models of care for future provision of big data. Such models can be used as a basis to inform future clinical documentation tools on self-care planning and pathway development contributing to the overall design for both the Personal Health Record (PHR) for individuals and Electronic Health Record (EHR) for service provision. Complementing clinical decision support, medication management and summary care records, such data provide not only critical support for optimal patient outcomes, patient safety and effective targeting of resources but also provides an opportunity to extract hidden knowledge and value to analyse and predict future health service provision.

Data sources

Search methods

To develop the discussion, a search of literature was performed using the database CINAHL and Pub-Med from January 2000–May 2015. The data sources were purposively sampled based on their relevance and contribution to building the discussion (Table 1). A decision concerning purposive sampling was achieved by consensus between the authors. The selection of sources was not undertaken using explicit systematic data processing principles and the aim was not to identify or include all relevant data sources. Key terms including nursing theory, nursing leadership, nursing and health informatics and integrated care were selected and used as a guide to develop the discussion. Seminal references prior to 2000 were also included.

Discussion

Nursing informatics and engagement in change process

An important aspect of the restructuring of health service delivery is the change process itself. While practical and institutional challenges remain, altering practice involves two key concepts, firstly *change processes* and secondly *transition processes* McLean (2011). Processes relating to change can be described as observable actions that happen or are done differently, usually involving alteration of structural processes on work practice routines.

Transition processes relate more to the emotional aspects around what people feel, experience, or consider important in their practice. Recognition that both concepts are required for successful integration of next generation models of healthcare delivery care is important (Hewitt-Taylor 2013).

As the single largest professional group in health care, nurses are recognized as being principal to health service delivery at both the managerial and clinical level. Nurses have played a central role in change and transformation of care delivery over many years, assuming leadership roles to initiate and augment change across all domains of health

Table 1 Summary of Data Sources.

Literature sources	Description	Key words
CINAHL	Database: Cumulative Index of Nursing and Allied Health Literature • Provides access to citations and full text articles on nursing and health science topics	Integrated care, nursing theory, nursing leadership, health informatics, nursing informatics
PubMed	Search engine: hosted by the National Library of Medicine in th USA • life science and biomedical informatics	Integrated care, internaional health, health infromatics, nursing informatics
Grey Literature	Industry publications Government publications	Integrated care, models of care, informatics
Books	Hannah, Hussey, Kennedy, & Ball (2014) Introduction to Health Informatics (4th edition)	Models of care, nursing leadership, nursing informatics

care. Nurses are also recognized as ideal candidates for leadership roles in implementing transitional programs of care (Leeman *et al.* 2007). At a policy level, the profession's values and priorities on future service delivery participation clearly reflect the prominence of patient safety and outcomes (Aiken *et al.* 2014). We therefore suggest that the profession acts as a scaffold supporting current healthcare delivery models, even in the fast moving, change-driven context of the digital age. Therefore, at first sight, nurses might not be the obvious place to look for redesigning and transforming health care. But as we discuss, nurses as holistic carers embody the qualities identified at a global policy level necessary to meet the challenges of implementing integrated health care.

There is a compelling argument for the nursing profession to confidently adopt a proactive approach to early engagement in the transformation of new models of integrated care delivery. Recent programs, which include technology deployment, have been described as a series of overlapping and often misunderstood language games that combine to produce a situation of ambiguity, paradox, incompleteness and confusion (Greenhalgh *et al.* 2010 p. 534, McEvoy 2014). Progressing to developing new models of service delivery is therefore critical, as limitations of the existing models that perpetuate the status quo, impact on quality of care, are recognized as no longer desirable or defensible. Survival strategies relating to integrated care delivery models for EU health care are now underway to ensure that funds to pay for healthcare and service delivery do not fall short of demand (Economist Intelligence Unit (The Economist) 2011).

In the context of nursing and health reform, NI is increasingly considered a key enabler in both change and transition processes and can recognized as a core skill for future health service delivery. Nursing Informatics is defined by the International Medical Informatics Association Nursing Specialist Interest Group (IMIA-NI SIG) as: a science and practice integrates nursing, its information and knowledge and their management with information and communication technologies to promote the health of people, families and communities world-wide (IMIA-NI 2009).

Blending informatics expertise with nursing's unique perspective on holistic health care ideally situates the profession to inform the integration of emerging models of care in a digital environment. Initially introduced by Francois Gremy, informatics was defined as 'the use of information technologies in relation to those functions within the purview of nursing that are carried out by nurses when performing their duties' (Ball & Hannah 1984 p.181*)*. At least 14 definitions of nursing informatics emerged over the subsequent decades. Most definitions agree that health informatics activities converge between computer science, information science and health science (Kennedy & Hussey 2014 p.23).

While nursing has already a rich history of philosophers and theoreticians who explore the knowledge of nursing and information to support healthcare delivery, what is now required is a focus on advancing nursing knowledge to a position of practice theory. Leveraging theoretical perspectives to identify strategic data collection that will advance the practice theory agenda is important to optimize effectiveness in health and social care. From the change process perspective, deployments of systems are failing to support holistic care (Takian *et al.* 2012, Watcher 2014). Table 2 provides broad examples of how nursing informatics provides much needed competencies and skills to

Table 2 Examples of Nursing Informatics Leadership Activity.

WHO 2015 Global Strategy on People Centered and Integrated Health Services Interim Report	Examples of nursing informatics leadership activity
Empowering and Engaging People	Development of Communities of Practice for education of individuals and communities on self-care management Example: ENS4Care (2014)
Strengthening Governance and Accountability	Adoption and use of new roles, emerging legislative and governance frameworks to support new approaches for care delivery Examples: IMIA Health Informatics Specialist Code of Ethics Framework, American Organization of Nursing Executives (AONE) Guiding Principles (2009)
Reorientation of Models of Care and Care Co-ordination	Use models for care which standardise concepts and terms for transitioning between primary, secondary and tertiary care e.g. Defining use case demonstrators for patient care flow and workflow analysis Example: Canadian Health Outcomes for Better Information and Care (2015)
Creating an enabling environment	Training and education strategies to support transition and change Example: The The Tiger Initiative (2013)

advance the strategic drivers as outlined in the WHO Interim Report on Integrated Care. Table 2 is supported with examples demonstrating how nursing informatics leadership activity is instantiating health and social care reform and supporting the WHO strategic enablers.

Strategic enabler 1: empowering and engaging people

The European Federation of Nurses is currently engaged in a project entitled ENS4Care. Redefining clinical guidelines on nursing practice, this project is focused on advancing roles, integrated care and prevention strategies in addition to nurse ePrescribing. This innovative initiative demonstrates existing practices across EU member states, which have been mapped to a set of core criteria for healthy lifestyle and prevention, early intervention and clinical practice in integrated care and skills development for advanced roles including Nurse ePrescribing (ENS4Care 2014). Work package 5 on nurse ePrescribing, for example, offers nursing leaders a roadmap on best available evidence on medication management, ePrescribing and eDispensing both from a legislative and governance perspective.

Strategic enabler 2: strengthening governance and accountability

The NI specialist plays a unique role in the planning and delivery of health care. Nurses abide by several codes of ethics including the IMIA *Code of Ethics*, which provide frameworks to conduct a set of principles against which the health informatics professional may be measured (International Medical Informatics Association 2011). Tantamount to this *Code of Ethics* is the need to provide the public with a clear statement of ethical considerations that shape the 'operations' when in development of electronic health records. For example, one focus is to ensure secure measures are in place to safeguard security, integrity, quality of material usability and accessibility of electronic health records (International Medical Informatics Association 2011). The American Organization for Nurse Executives (AONE) provided a suite of guiding principles and recommended clearly defined roles, communications and responsibilities to support change. One example is the guiding principle for nurse executives to enhance clinical outcomes by leveraging technology (AONE 2009). Such resources support the need for and advancement of informatics skills as a priority, recognizing technology as a key lever in future healthcare delivery.

Strategic enabler 3 and 4: reorientation of models of care and co-ordination of services

Canadian Health Outcomes for Better Information and Care (C-HOBIC) is a Canadian Approved Standard for nursing and offers a suite of nursing sensitive patient outcomes for use in four domains of practice – acute care, home care, complex continuing care and long-term care (Hannah *et al.* 2012, C-HOBIC 2015). C-HOBIC, purposefully designed for integrated care delivery, provides mechanisms to systematically record patient-centric data across time intervals. This holistic suite of patient outcome data includes five distinct clusters such as functional status and therapeutic self-care. C-HOBIC also collects information on symptom management, exposing where additional efforts are required to support patients' and carers' educational needs (Kennedy & Hussey 2014, Hannah & White 2015). Currently in use in all four specific domains in Canada (Woodchis *et al.* 2012), C-HOBIC offers a clinically pragmatic tool to assess and inform care provision supporting patient transitions on discharge and transfer. Linking C-HOBIC data to other key national data holdings provides even stronger evidence to innovate healthcare systems. One outstanding example of this is Woodchis *et al.*'s work on the C-HOBIC Therapeutic Self Care (TSC) measures in relation to the Canadian national Discharge Abstract Database (DAD), illustrating the impact of the TSC on patient readmission rates (C-HOBIC 2015).

Strategic enabler 5: creating an enabling environment

Change is often described as an emotionally charged process. Reports indicate that dissatisfaction is high among nurses and physicians on existing change program initiatives. Quality of care is continually challenged by the negative effect that transformation driven by technology adoption places on clinical practice (Takian *et al.* 2012). Identifying the possible shortcomings, consequences and potential impact of transitional change is therefore important and devising strong leadership to manage change is a critical component for effective delivery. Strategies that include enhanced participatory approaches are recommended to support clinicians, optimize adoption and monitor the impact on service delivery during transition. Key areas of focus include measurement of existing standards of care and monitoring of patient mortality indicators (Napier *et al.* 2014).

Global initiatives that support the use of participatory methods adopting socio-technical approaches to advance nursing practice while influencing transformation include the Technology Informatics Guiding Educational Reform initiative (TIGER). Created in 2004, TIGER is a global nurse-led community who use existing core values to provide insight on supporting activities that demonstrates nursing involvement in creating a new paradigm of integrated care (The TIGER Initiative 2013). Examples of activities

where the profession can contribute include mapping of workflow delivery mechanisms for more effective use of health information exchange and continuity of care.

The Scape Report (Begley *et al.* 2010), reviewing contemporary nursing roles in advanced and clinical practice, demonstrated expertise on critical contextual knowledge. Specifically, the report notes nursing expertise on aspects of care such as diffusion of innovation for efficient delivery mechanisms and informal communication on continuity of care to maintain patient safety. Additional examples of how nursing can shape transition from different aspects of the care across the continuum may be viewed from three distinct aspects: 1) Mapping care delivery, 2) Data quality and 3) Patient and care involvement in self-care practices.

Mapping care delivery. Nursing practice interventions are described by Potts *et al.* as 'largely unpredictable, close to the patient and difficult to codify' (Potts *et al.* 2011 p.28). Potts presents nursing knowledge and expertise as an opportunity to bridge the gap between the formal and informal, the social and technical. By adopting the role of potential mavericks in change management (Gladwell 2001), nurses can assist in transformation at a local level, becoming innovators and early adopters for embedding new care flow processes into clinical practice for greater efficiency and effective system deployment. A recent Irish example is Hussey and Rodger's (2014) use case report, which defines nursing roles and interagency communication and demonstrates requirements for future care models.

Canada's Ontario Ministry of Health and Long Term Care (2015) recently published a new vision for home care in Patients First: A Roadmap to Strengthen Home and Community Care. This report outlines the importance of carers' roles, expanding caregiver support and noted that consultation will be conducted with patients, carers and providers to develop a new Levels of Care framework. Disappointingly, the report referred to the necessity of nursing visits in home care and failed to recognize that nurses are ideally positioned to lead these service user and provider consultations, the planned expanded education for carers and the framework redesign process. Nurses can and should be, advocating to lead these types of consultations and redesign work, leveraging both the strategic and tactical strengths of nursing knowledge.

Data quality. Pesut and Herman (1998, 1999) first identified the knowledge work of nurses in their analysis on the evolution of the nursing process and later expanded this discussion in the context of clinical reasoning. Matney *et al.* (2010) further contemporized this concept in the digital era, noting that nurses are knowledge workers who translate data to information, information to knowledge and knowledge to wisdom. As technology advances and debates on how large databases of service user information are available, the need for data quality is recognized as core to future service delivery. Harrington (2011, p.509) emphasized the necessity of data quality, noting the potential for a 'landslide of poor quality data' to negatively impact clinical outcomes and system efficiencies. Recent work has further called on nurse leaders to establish competencies in how to best leverage knowledge generated through Big Data to control costs, support patient quality and safety and to transform health care (Westra *et al.* 2015).

Education. Understanding the importance and centrality of the nursing profession's role in defining context for education and training with external stakeholders is also essential. Nursing must actively pursue early engagement with public and private industry partners to ensure their contribution and concerns regarding the feasibility of proposed models are understood. In some circumstances, professional groups such as European Federation of Nurses (EFN), are assuming the role of guardians of care for EU citizens. Adopting an ethical stance and seeking clarity with vendors on how smart technology uptake and use will manage data with regard to healthcare service provision is another example. Additional examples include the recent reports from EFN, which critically appraise green papers on mobile devices and pose questions seeking clarity on the efficiency gains achieved for service users and health services alike (EFN 2015).

Education in the National Health Service in the UK also identifies focused nursing engagement in training and education of service users and carers in self-management, particularly with regard to medication management uptake and use and application of mobile and smart devices (National Health Service 2014). Regional examples from Ireland demonstrate nursing leadership in action for self-care management and include a self-care program on bone health and falls risk prevention (Rodger & Spencer 2013) and are available to view online (Rodger & Spencer 2014).

Instantiating informatics in nursing practice

To instantiate broadly means to represent a universal or abstract concept using an actual example. Historically, nursing contributions to healthcare leadership at critical intersections over time have been important. Specific early examples include Nightingale's definition of the Rose Diagram as a statistical tool to define service delivery needs.

This statistical tool emerged from Nightingale's ability to identify the problem at a time in context and provide a practical solution to address the problem in the form of a data reporting resource, which illustrated information on population health issues (Nightingale 1863).

Today, we argue the case that informatics as a universal concept can elevate both nursing practice and patient requirements by identifying existing problems that may be (in part) addressed by technology enhanced solutions. To advance the contemporary nursing agenda, nurse leaders must first recognize informatics as the instigator. This recognition springboards nurse leaders into critical discourse on mechanisms to instantiate essential clinical knowledge in an interdisciplinary vision for new care delivery. Existing Information and Communication Technology (ICT) in health and social care do not acknowledge the value of nursing data. Identifying and compiling essential nursing data into suitable and concise frameworks for deployment in Electronic Health Records for integrated care therefore remains an important issue that is under recognized and under addressed. Adovasio *et al.* (2007) describes practice based nursing theory as travelling nets constructed on the go, evolving organically and capable of adapting to meet the needs of complex changing environments. Engagement of the profession in participatory solutions which can co-construct and co-create contemporary health care will initiate new configurations, align new practices and create new roles to connect individuals at both an institutional and societal level.

The Scape Report (Begley *et al.* 2010), despite offering concrete examples of contemporary nursing roles in advanced practice including the promotion of self-management skills, holistic assessment for early diagnosis and the building of a strong therapeutic relationship with service users for self-management, does not offer strategic direction for informatics role development. The absence of the nursing voice from recent change programs has been reported as impacting the successful scope and delivery of recent transformational program initiatives in England (Royal College of Nursing 2012). There is evidence that, to some extent, this message in the nursing profession has been translated in some countries across the EU. For example, nursing leaders in Sweden have published nursing informatics strategies for future integrated models of health care (Swedish Society of Nursing 2013). The European Science Foundation calls on key stakeholders to develop a new understanding on enabling health and well-being in Europe, proposing informatics support as a key enabler for harmonizing health and social care in Europe (Rigby & Hill 2013). It is imperative for both the profession and for the public that nursing actively leads the shift in how healthcare professionals value technology in front line care delivery and advance the progression towards integrated health.

Implications for nursing

The key drivers to ensure optimum health and social care provision include recognizing the value of the nursing contribution to individualized care, protecting this valuable but often invisible contribution as we migrate to an increasingly digitalized healthcare landscape and exposing the potential vulnerability created by a lack of engagement in future plans for health reform processes. Strategically ensuring early nursing engagement in planning on national and regional translational programs is highly recommended. Examples of resources from AONE offer guiding principles on how nursing as a profession can leverage technology (American Organization of Nursing Executives 2009), but first nursing leaders must redirect their thinking to sourcing concrete solutions to the challenges that lie ahead and raising awareness with colleagues to understand the significance of inaction on this important topic. In addition, nurse leaders must take action in the development of needed informatics skills and knowledge and finally to engage clinical nurses with the right expertise early in the acquisition and design phases of program implementation to ensure that integrated models of care are optimally positioned to achieve success in adoption and use (Nagle 2014).

In particular, it is recognized that the nursing profession needs to integrate informatics into formal and informal education and training programs and translate this into competencies of current and future nurse leaders (Remus & Kennedy 2012, CASN 2015). The nursing role in meeting the challenges of developing integrated models of care will face several obstacles which will have implications for the profession itself. Implications include the training and education of nurses in understanding the value of their contribution, the scope of the professional relationship of nursing with the multi-disciplinary team, embracing new ways of working and leveraging technology to effectively support new ways of providing effective, timely and appropriate care. One example is in the area of nurse ePrescribing where jurisdictional and governance issues need to be considered carefully (Kroezen *et al.* 2011). Future engagement in the development and use of assessment data such as C-HOBIC migrates the profession towards inter-professional approaches offering greater potential to progress an integrated patient-centred service delivery agenda.

Instantiating informatics can assist in informing the strategic direction of nursing and assist in making evident the nursing agenda in future healthcare provision.

Conclusion

Nursing is at cross-roads of opportunity, where the strategic positioning of the profession to lead and influence change at an institutional and societal level is now apparent. Reflecting on our historical influences on transformation in health service delivery, the profession can mediate new roles underpinned with core values such as empathy in addition to expertise and clinical knowledge. Using informatics as an instigator, nurse leaders can address healthcare challenges and provide ethical solutions to address the challenges that prevail between the contextual elements of complex and dynamic healthcare delivery. Nursing theory integrated with interdisciplinary and patient-centred participatory approaches will provide scope for the profession to be a recognized and valued contributor to integrated interprofessional care. Nurses not only need to understand the importance of their role in the transformational process as both content and context experts but they must also actively engage at a multidimensional level to ensure their contributions are understood, that patients are positioned centrally and considered holistically and that collaboration is the hallmark of innovative, integrated and technology-enabled care.

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- substantial contributions to conception and design, acquisition of data or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

References

Abramson E.L., Patel V., Malhotra S., Pfoh E.R., Osorio S.N., Cheriff A., Cole C.L., Bunce A., Ash J. & Kaushal R. (2012) Physician experiences transitioning between an older versus newer electronic health record for electronic prescribing. *International Journal of Medical Informatics* **81**(8), 539–548.

Adler-Milstein J. & Bates D.W. (2010) Paperless healthcare: progress and challenges of an IT-enabled healthcare version 1.0. *Business Horizons* **53**(2), 119–130.

Adovasio J.M., Soffer O. & Page J. (2007) *The Invisible Sex: The True Roles of Women In Prehistory*. Smithsonian, New York.

Agency Healthcare Research and Quality (2014) *Care Co-ordination measurement atlas*. AHRQ Pub No.14-0037-EF California. Retrieved from www.ahrq.gov on February 2014.

Aiken L.H., Sloane D.M., Bruyneel L., Van den Heede K., Griffiths P., Busse R., Sermeus W. & Scott P.A. (2014) Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *The Lancet* **383**(9931), 1824–1830.

American Organization of Nursing Executives (2009) Guiding Principles. Retrieved from http://www.aone.org/search?q=Guiding+Principles&site=AONE&client=AONE_FRONTEND_1&proxystylesheet=AONE_FRONTEND_1&output=xml&filter=0&oe=UTF-8 on 02 April 2014.

Ball M. & Hannah K. (1984) *Using Computers in Nursing*. Reston, California.

Begley C., Murphy K., Higgins A., Elliott N., Lalor J., Sheerin F., Coyne I., Comiskey C., Normand C., Casey C., Dowling M., Devane D., Cooney A., Farrelly F., Brennan M., Meskell P. & MacNeela P. (2010) *Evaluation of Clinical Nurse and Midwife Specialist and Advanced Nurse and Midwife Practitioner Roles in Ireland (SCAPE): Final Report. National Council for the Professional Development of Nursing and Midwifery in Ireland*. Dublin, Ireland. Retrieved from http://www.nursingmidwifery.tcd.ie/assets/research/pdf/SCAPE_Final_Report_13th_May.pdf on 13 February 2015.

Brennan P. & Bakken S. (2015) Nursing needs big data and big data needs nursing. *Journal of Nursing Scholarship* **47**(5), 477–484.

Canadian Association of Schools of Nursing (2015) *Nursing Informatics: Entry-To-Practice Competencies for Registered Nurses*. Retrieved from http://www.casn.ca/2014/12/casn-entry-practice-nursing-informatics-competencies/ on 12 January 2015.

Canadian Health Outcomes for Better Information and Care (2015) *C-HOBIC: Phase 2 Final Report* (2014). Retrieved from http://c-hobic.cna-aiic.ca/documents/pdf/Canadian-Health-Outcomes-for-Better-Information-and-Care_C-HOBIC-Phase-2_Final-Report_January-2015.pdf on 10 April 2015.

Doyle J. & Walsh L. (2014) Independent living applications. In *An Introduction to Nursing Informatics*, 4th edn (Hannah K., Hussey P., Kennedy M.A. & Ball M., eds), Springer, London, pp. 177–211.

Economist Intelligence Unit (The Economist) (2011) The Future of Healthcare in Europe. Retrieved from http://www.janssen-emea.com/sites/default/files/The-Future-Of-Healthcare-In-Europe.pdf Geneva on 01 December 2014.

ENS4Care (2014) *ENS4Care Best Practices Work Package 5: Nurse Eprescribing*. Retrieved from http://www.ens4care.eu/category/best-practices/ on 18 July 2015.

European Commission (2012) *A Digital Agenda For Europe: A Europe 2020 Initiative*. Retrieved from https://ec.europa.eu/digital-agenda/ on 17 November 2014.

European Commission (2013) *CEN Green Paper: Mobile Health (MHealth)*. Retrieved from http://ec.europa.eu/digital-agenda/en/news/green-paper-mobile-health-mhealth on 12 February 2015.

European Federation of Nursing (2015) EFN Briefing Note: Comment to the EC Public Consultation on the Green Paper on Mobile Health 26 January 2015. Retrieved from http://www.efnweb.be/?page_id=882 on 2 February 2015.

Gladwell M. (2001) *The Tipping Point*. Little Brown, London.

Greenhalgh T., Stramer K., Bratan T., Byrne E., Russell J. & Potts W. (2010) Adoption and non-adoption of a shared electronic summary in England: a mixed methods case study. *The British Medical Journal* **340**(c 3111). Retrieved from http://www.bmj.com/content/340/bmj.c3111 on 3 February 2014.

Hannah K. & White P. (2015) *C-HOBIC: Creating the Case for Data Standards for Clinicians*. Paper presented at eHealth 2015, Toronto, Canada.

Hannah K., White P.A., Kennedy M.A. & Hammell N. (2012) C-HOBIC – standardized information to support clinical practice and quality patient care across Canada. In *Nursing Informatics 2012: Proceedings of the 11th International Congress on Nursing Informatics*, American Medical Informatics Association, Montreal, Canada, pp. 142–147.

Harper E. (2014) Can big data transform electronic health records into learning systems. *Student Health Technology Information* **201**, 470–5.Retrieved from http://www.pubfacts.com/detail/24943583/Can-big-data-transform-electronic-health-records-into-learning-health-systems? on 12 February 2015.

Harrington L. (2011) Clinical intelligence. *Journal of Nursing Administration* **41**(12), 507–509.

eHealth Ireland (2013) *EHealth Strategy for Ireland*. Retrieved from http://health.gov.ie/blog/publications/ehealth-strategy-for-ireland/ on 02 April 2014.

Hewitt-Taylor J. (2013) Planning successful change incorporating processes and people. *Nursing Standard* **27**(38), 35–40.

Hussey P. & Rodger D. (2014) *Nursing Roles and Interagency Communication Demonstrating Requirements for Future Models of Care*. Health Informatics Society of Ireland Nursing and Midwifery Report ISBN 978-1-873769-26-3. Retrieved from http://doras.dcu.ie/view/people/Hussey,_Pamela.html on 29 January 2015.

Hussey P., Kennedy M.A. & Spencer A. (2014) History of computing and technology. In *An Introduction to Nursing Informatics*, 4th edn (Hannah K., Hussey P., Kennedy M.A. & Ball M., eds), Springer, London, pp. 53–78.

International Medical Informatics Association (2011) *A Code of Ethics for Health Informatics Professionals*. Retrieved from http://www.imia-medinfo.org/new2/pubdocs/Ethics_Eng.pdf on 17 July 2015.

International Medical Informatics Association Nursing Interest Group (IMIA NI) (2009) *Definition*. Retrieved from http://imia-medinfo.org/ni/node/28 on 17 November 2014.

Kennedy M.A. & Hussey P. (2014) Nursing informatics. In *An Introduction to Nursing Informatics*, 4th edn (Hannah K., Hussey P., Kennedy M.A. & Ball M., eds), Springer, London, pp. 11–31.

Kroezen M., Van Dijk L., Groenewegen P.P. & Francke A.L. (2011) Nurse prescribing of medicines In Western European and Anglo-Saxon countries: a systematic review of the literature. *Bio Med Central Health Service Research* **11**, 127. Retrieved from http://www.biomedcentral.com/1472-6963/11/127 on 02 December 2014.

Laney D. (2001) 3D Data Management: Controlling Data Volume, Velocity and Variety. Retrieved from http://blogs.gartner.com/doug-laney/deja-vvvue-others-claiming-gartners-volume-velocity-variety-construct-for-big-data/ on 20 October 2015.

Leeman J., Baernholdt M. & Sandelowski M. (2007) Developing a theory-based taxonomy of methods for implementing change in practice. *Journal of Advanced Nursing* **58**(2), 191–200.

Matney S., Brewster P., Sward K., Cloynes K. & Staggers N. (2010) Philosophical approaches to nursing informatics data-information-knowledge-wisdom framework. *Advances in Nursing Science* **34**(1), 6–18.

Mayer-Schonberger V. & Cukier K. (2013) *Big Data a Revolution That Will Transform how we Live Work and Think*. Houghton Mifflin Harcourt, New York.

McEvoy P. (2014) *Chronic Disease Management*. Radcliffe, London.

McLean C. (2011) Change and transition: what is the difference? *British Journal of School Nursing* **6**(2), 78–81.

Nagle L.M. (2014) The role of the informatics nurse. In *An Introduction to Nursing Informatics*, 4th edn (Hannah K., Hussey P., Kennedy M.A. & Ball M., eds), Springer, London, pp. 251–270.

Napier A.D., Ancarno C., Butler B., Calabrese J., Chater A., Chatterjee H., Guesnet F., Horne R., Jacyna S., Jadhav S., Macdonald A., Neuendorf U., Parkhurst A., Reynolds R., Scambler G., Shamdasani S., Smith S.Z., Stougaard-Nielsen J., Thomson L., Tyler N., Volkmann A.M., Walker T., Watson J., Williams A.C., Willott C., Wilson J. & Woolf K. (2014) Culture and health. *Lancet* **384**, 1607–1639. Retrieved from http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(14)61603-2.pdf on 12 June 2015.

National Health Service (2014) *Using Data and Technology to Transform Outcomes for Patients and Citizens. A Framework for Action*. Retrieved from https://www.gov.uk/government/publications/personalised-health-and-care-2020 on 13 January 2015.

Nightingale F.N. (1863) *Notes on Hospitals*. Enlarged and rewritten, 3rd edn. Longman Roberts and Green, London, pp. 175–176.

Nolte E. & Pitchford E. (2014) *What is the Evidence on the Economic Impacts of Integrated Care?* European Observatory of Health Systems and Policies. Retrieved from http://www.euro.who.int/__data/assets/pdf_file/0019/251434/What-is-the-evidence-on-the-economic-impacts-of-integrated-care.pdf?ua=1 on 31 October 2014.

Oakes M., Frisch N., Potter P. & Borycki E. (2015) Readiness of nurse executives and leaders to advocate for health information systems supporting nursing. *Studies in Health Technology & Informatics* **208**, 296–301.

Ontario Ministry of Health and Long Term Care (2015) Patients First: A Roadmap to Strengthen Home and Community Care. Retrieved from http://www.health.gov.on.ca/en/public/programs/ccac/roadmap.pdf on 12 July 2015.

Orem D.E. (1991) *Nursing: Concepts of Practice*, 4th edn. Mosby, St Louis.

Organization of Economic Co-Operative Development (2010) *Improving Health Care Efficiency the Role of ICT* [eBook]. Retrieved from http://ec.europa.eu/health/eu_world/docs/oecd_ict_en.pdf on 2 December 2014.

Pan American Health Organization (2012) *EHealth Strategy and Plan of Action*(2012-2017). Retrieved from http://new.paho.org/ict4health/ on 17 November 2014.

Pesut D.J. & Herman J. (1998) OPT: transformation of nursing process for contemporary practice. *Nursing Outlook* **46**, 29–36.

Pesut D.J. & Herman J. (1999) *Clinical Reasoning: The Art and Science of Critical and Creative Thinking*. Delmar, Albany, NY.

Potts H.W., Keen J., Denby T., Featherstone I., Patterson D., Anderson J., Greenhalgh T., Colligan L., Bark P., Nicholls J., Shah A., Swinglehurst D., Wong G., Martin C. & Blandford A. (2011) *Towards a Better Understanding of Delivering E-Health Systems: A Systematic Review Using the Meta-Narrative Method and Two Case Studies*. Final Report. NIHR Service Delivery and Organization Program. Retrieved from http://www.netscc.ac.uk/hsdr/files/project/SDO_FR_08-1602-131_V01.pdf on 12 April 2015.

Remus S. & Kennedy M.A. (2012) Innovation in transformative nursing leadership: nursing informatics competencies and roles. *Canadian Journal of Nursing Leadership* **25**(4), 14–26.

Rigby M.(2014) The core vision of person-centred care in a modern information-based society. In *Achieving Integrated ECare Beyond the Silos in the Advances in Healthcare* (Myer I., Müller S. & Kubitschke L., eds), IGI Global book series Advances in Healthcare Information Systems and Administration (AHISA), Hershey, PA: IGI Global. doi:10.4018/978-1-4666-6138-7 pp. 1–21.

Rigby M. & Hill P., European Science Foundation (2013) *Developing a New Understanding of Enabling Health and Wellbeing in Europe: Harmonising Health and Social Care Delivery and Informatics Support to Ensure Holistic Care*. Science Position Paper. EU: European Science Foundation. Retrieved from http://www.esf.org/fileadmin/Public_documents/Publications/Health_Wellbeing_Europe.pdf on 20 September 2014.

Rodger D. & Spencer A. (2013) *Bone Health in the Park*. Retrieved from www.bonehealth.co on 12 February 2015.

Rodger D. & Spencer A.(2014) *Forever Autumn Community of Practice*. Retrieved at www.foreverautumn.co on 12 February 2015.

Roper N., Logan W. & Tierney A. (1990) *The Elements of Nursing: A Model for Nursing Based on a Model of Living*. Churchill Livingstone, Edinburgh.

Royal College of Nursing (2012) *Positioning Nursing in Digital World*. RCN EHealth Survey Report. Retrieved from http://www.rcn.org.uk/__data/assets/pdf_file/0020/530390/004_440.pdf on 12 February 2015.

Swedish Society of Nursing (2013) *EHealth: A Strategy for Nursing*. Report ISBN: 978-91-85060-20-7. Retrieved from www.swenurse.se on 12 November 2015.

Takian A., Petrakaki D., Cornford T., Sheikh A. & Barber N. (2012) Building a house on shifting sand: methodological considerations when evaluating the implementation and adoption of national electronic health record systems. *Bio Medical Central Health Services Research* **12**(105). Retrieved from http://www.biomedcentral.com/content/pdf/1472-6963-12-105.pdf on 13 February 2015.

The TIGER Initiative (2013) What is TIGER? Retrieved from http://www.thetigerinitiative.org on 24 April 2014.

Watcher R. (2014) Meaningful Use Born 2010 Died 2014. *Healthcare IT Newsweek* **11**(47). Retrieved from http://www.healthcareitnews.com/blog/meaningful-use-born-2009-died-2014 November 13th 2014 on 17 November 2014.

Westra B.L., Clancy T.R., Sensmeier J., Warren J., Weaver C. & Delaney C.W. (2015) Big data science – implications for nursing leaders. *Nursing Administration* **39**(4), 304–310.

Woodchis W.P., Ma X., Simeonvov D., Stamplecoski M., White P., Purdy I., Jeffs L., Iron K., De Nobrrega P. & McGillis-Hall L. (2012) *Health Outcomes for Better Information and Care (HOBIC): Acute Care in Ontario* (ICES Report). Retrieved from www.ices.on.ca/Publications/Atlases-and-Reports/2013/HOBIC-2012 on 1 February 2014.

World Health Organization (2005) *Preventing Chronic Disease: A Vital Investment*. WHO, Geneva. Retrieved from http://www.who.int/chp/chronic_disease_report/en/ on 12 February 2015.

World Health Organization (2014) *Global Health Observatory*. Retrieved from http://www.who.int/gho/publications/world_health_statistics/en/index.html on 1 December 2014.

World Health Organization (2015) WHO Global Strategy on People Centered and Integrated Health Services Interim Report. Retrieved from http://www.who.int/servicedeliverysafety/areas/people-centred-care/global-strategy/en/ on 12 May 2015.

