THE COMMONWEALTH FUND
20XX – 20XX HARKNESS FELLOWSHIP IN HEALTH CARE POLICY AND PRACTICE
APPLICATION FORM

PRELIMINARY RESEARCH PROPOSAL

"The Effect of the Implementation of an Electronic Health Record on Nursing-Sensitive Patient Outcomes"

A. Purpose and Context

Current policy in both the U.S. and U.K., as well as other developed countries, involves the introduction of information technology systems, such as electronic health records (EHR), computerized physician order entry systems (CPOE) and computerized decision support systems (CDSS) as a way of helping to improve the quality and safety of care that patients receive (Institute of Medicine 2001, Department of Health 2002). Key processes of decision making include information searching and the evaluation of knowledge to reach a judgment or decision (Thompson & Dowding 2002). Information technology systems may be designed to support some or all of these decision processes, with the assumption that improving the ability to identify evidence, or assist with the integration of evidence, will improve the quality of care patients receive. Such health care information technology systems certainly have the potential to improve care quality. For instance the use of CPOE systems has been linked to significant reductions in adverse drug events and medical error rates, by improving the legibility of drug orders and the provision of alerts for drug interactions (Wolfstadt et al 2008, Kaushal et al 2003). Other information technology systems such as CDSS can improve preventive health care delivery such as increased vaccination rates and diabetes management, through the provision of reminders and evidence based guidance (Chaudry et al 2006, Garg et al 2005). The use of information technology in health care has also been associated with decreased rates of health services utilization (Chaudry et al 2006). However, the introduction of information technology into health care may also have unintended consequences with negative effects on the quality of care that patients receive. Examples include physicians activating a medical order after the medication has actually been given (in an urgent situation), which means it could be given again once the order has been activated (Ash et al 2004), and nurses 'manipulating' a decision support system to give them the answer that fits with their assessment of the patient (Dowding et al 2009, O'Cathain et al 2004), potentially leading to an inaccurate assessment of the patient's condition.

The implementation of health information technology involves significant financial investment from health care providers. Therefore policy decision makers need to have a good understanding of how information technology systems can be implemented effectively, and how they are subsequently used by health care staff once they have been embedded within work processes. Despite the fact that nurses comprise a significant part of the health care workforce, comparatively little is known about how they use information technology to inform the decisions they take. It is unclear what impact nurses' use of information technology may have on the quality and safety of the care they deliver. Nurses comprise a significant part of the workforce in both the U.S. and the U.K. (U.S. Census Bureau 2004/5, The Information Centre 2008) and have a central role in the delivery of health care. Nurses' work is complex, involving the co-ordination of patient care and communication with a variety of other health care professionals and patients (Ebright et al 2003). In high income countries they are also taking on extended roles, often supported by technology such as computerized decision support (Randell et al 2007). Nurses make different types of decisions than their medical colleagues, and therefore the way in which they use information technology may also differ (Hughes 2008). Unlike in medicine, in nursing there is limited evidence that using information technology such as computerized decision support will improve care quality (Randell et al 2007). In the majority of studies that have evaluated the use of information technology systems in health care, nurses as users of those systems are largely absent (Staggers et al 2008).

A number of indicators have been identified by the National Quality Forum (2004) as being sensitive to the quality of nursing care provided by a health care organization. These include;

- Death among surgical inpatients with treatable serious complications (failure to rescue)
- Pressure ulcer prevalence
- Falls prevalence
- Falls with injury
- Restraint prevalence
- Urinary catheter-associated urinary tract infection for intensive care (ICU) patients
- Central line catheter-associated blood stream infection rate for ICU and high risk nursery (HRN) patients
- Ventilator-associated pneumonia for ICU and HRN patients (National Quality Forum 2004)
- Medication administration

A number of these measures are also National Patient Safety Goals (Joint Commission 2009), and prevention of pressure ulcers is one of the priorities listed in the Institute for Health Improvement's 5 Million Lives Campaign (an initiative to improve both the safety and quality of care in hospitals in the U.S.) (McCannon et al 2007). Reducing the prevalence of such indicators are therefore a priority for nursing care in terms of patient safety and the quality of care received by patients in hospital settings.

Kaiser Permanente (KP) is the largest nonprofit health plan in the U.S., providing health care services to approximately 8.6 million members across eight regions. KP has implemented an integrated electronic health record (known as KP HealthConnect), across all eight regions in both primary care and hospital facilities. The system is used by all health care staff, and includes a number of embedded evidence-based rules and documentation tools. The use of such formalized evidence-based protocols at the point of care has the potential to improve the quality of care delivered by nurses and subsequent nursing-sensitive patient outcomes.

The proposed study aims to examine the impact of the implementation of KP HealthConnect on the prevalence of a number of nursing-sensitive patient outcomes in hospital settings. The study will address the following research objectives:

1. Analyze the effect of introducing an Electronic Health Record (EHR) KP HealthConnect on the prevalence of nursing-sensitive patient outcomes in hospital settings.
2. Explore the impact of an Electronic Health Record (EHR) KP HealthConnect on nurses' decision making regarding the care of patients related to nursing-sensitive patient outcomes.

B. Research Design
In order to address objective 1, an interrupted time series (ITS) design will be used. ITS is the strongest quasi-experimental design for evaluating the effect of an intervention over time (Wagner et al 2002). In an ITS data on an outcome measure is collected at multiple time intervals before and after an intervention (Wagner et al 2002, Ramsey et al 2003). Analysis of time series data enables the examination of whether (and how much) an intervention has changed the outcome of interest, whether that change has occurred immediately or over time, whether the change is transient, whether the intervention has a delayed effect or whether the change has occurred immediately (Wagner et al 2002).

Intervention
The intervention of interest is the implementation of KP HealthConnect within the clinical environment of acute clinical areas. The period of implementation (intervention) will be taken as the point in time from when the system was introduced into the clinical area to the point at which it was considered to be in use to its full functionality by all clinical staff.

Outcome measures
A subset of nursing-sensitive patient outcomes will be selected for the study, based on the availability of routine data sources. The primary outcome measure of interest is the prevalence of identified outcomes at particular time points (e.g. the number of patients with a pressure ulcer/1000 patient

days). Where possible a number of process measures indicative of the quality of care will also be collected (e.g. the number of patients assessed using the Braden Scale within 8 hours).

Where possible routinely collected data will be used as the basis for the ITS analysis. Aggregated data for the frequency of occurrence of each of the outcome measures will be collected at monthly time intervals for at least 3 months before the intervention and 3 months post-implementation in each of the hospital care providers in KP. Three months is the minimum number of time points recommended by the Effective Practice and Organization of Care (EPOC) Cochrane Group for an ITS design (Ramsey et al 2003).

Control Group
As the implementation of the EHR has been staged, the time point at which the intervention has occurred is different in different acute health care providers across KP. Therefore, health care providers where the implementation of KP HealthConnect has occurred later on in the cycle of implementation will be used as a control group, to assess the potential effect of any external influences on changes in the outcome measures of interest.

Analysis
Data will be plotted to examine trends in changes in outcomes over time. Data will also be analyzed using established statistical techniques for the analysis of ITS, depending on the number of time points before and after intervention. These would include analysis of variance, segmented regression analysis (Wagner et al 2002), or autoregressive integrated moving average models (ARIMA) (Ramsey et al 2003). Data will be corrected for autocorrelation and any seasonal variations in outcome measures (Wagner et al 2002).

Objective 2:
In order to address objective 2, a case study design will be used (Yin 2003). Two clinical units will be selected as case sites for the study, selected to represent variations in both trends for nursing-sensitive outcomes and time scales for the implementation of KP HealthConnect.

Data Collection
The study will use a variety of different methods of data collection to explore how KP HealthConnect is used by nurses in practice to assist with their decision making. The triangulation of data derived from different data collection methods also enables the identification of areas of convergence, divergence and contradictions within the data (Keen 2006). Methods include:
- Contextual data describing the nature of the case site, including numbers of nurses and other health care staff, experience of staff, length of time the system has been in use, type of patients and (where relevant) characteristics of the specific elements of KP HealthConnect.
- Non-participant observation of how nurses make decisions using KP HealthConnect.
- Interviews with nurses to explore issues related how they use KP HealthConnect to make decisions in practice.
- Data mining the information inputted into KP HealthConnect to examine whether or not protocols are being adhered to.

Data Analysis
The majority of data will be qualitative and analysed using thematic analysis (Pope et al 2006), assisted by the use of computer package such as Atlas-ti. Data from observation and interviews with nurses will be used to describe how the system is actually used in practice. This will be compared to the analysis of how it should ideally be used (from data mining), to identify areas of correspondence and divergence. The results of this analysis can be used to assist with improving the quality of nursing care related to nursing-sensitive patient outcomes within KP HealthConnect.

C. Expected Contributions of the Proposed Research:
The results of this study will have implications for health policy internationally, for countries where information technology is being planned or has been introduced into health care systems. The study will examine how nurses use technology such as Electronic Health Records, and how this relates to the quality and safety of care patients receive. Study results can be used by policy makers to inform subsequent decisions on the design, implementation and evaluation of computer-based technology in the future. The results will provide insights into the education needs of health care professionals using computer-based technology, the factors that influence the successful implementation and use of such systems, and factors that may result in less than optimal use of Electronic Health Records. Comparing the results of this study with those of previous work (Dowding et al 2009) will identify whether there are elements of nurses' use of such systems that are culturally specific and whether there are elements that are generic across different contexts.

D. Dissemination Strategy
There are a number of target audiences for the proposed research including academic researchers, health care managers responsible for the purchase and implementation of health information technology systems, health care professionals (including nurses, doctors and allied health professionals), health educators and policy makers. Ensuring that the results of this study are understood and used by all of these different stakeholders requires a recognition that the process of research use is iterative and continual (Davies et al 2008). In order to facilitate the use of research a two-way process of communication between researchers and potential users of research is necessary (Lomas 2007, Innvær et al 2002). I therefore propose establishing a stakeholder forum, with representatives from organizations and professional groups that have an interest in the proposed study (e.g. Agency for Healthcare Research and Quality, American Nurses Association, Veterans Health Administration, Kaiser Permanente, American Medical Informatics Association, Siemens Medical Solutions, Cerner) who would meet with me at various points during the study to discuss the study aims, procedures and outputs. I would envisage this as a process, where the stakeholders inform the nature and progress of the study, and where I provide feedback on the progress and results of the study. The identification of potential stakeholders would be in consultation with my mentors both in the U.K. and the U.S.

In consultation with the stakeholder forum I also propose to produce various summaries of the research which have clear recommendations for each of the different stakeholder groups (Innvær et al 2008), which can be used to facilitate dissemination. In addition I would also disseminate the findings in more traditional academic forums such as professional journals and conference presentations.

E. Workplan

Prior to starting:
- Identification of possible stakeholders

September – November 2009:
- Familiarization with U.S. health care context
- Identification of data to be used in ITS study
- Initial meetings with potential stakeholders in the U.S.

November 2009 – January 2010:
- Analysis of data for the ITS study
- Identification of case site(s)
- Discussion of progress and preliminary results with stakeholder groups

February – April 2010:
- Data collection from case sites
- Analysis of case site data

April 2010 – August 2010
- Completion of case site analysis
- Production of research summaries with clear recommendations for stakeholder groups

- Seminars with stakeholder forums to discuss results
- Presentation of findings at departmental seminars, conferences, preparation of papers for publication.

Deliverables: Summary of research with clear recommendations for different stakeholder groups. I intend to produce two main papers; the first an analysis of the implications of nurses' use of the Electronic Health Record for the quality and safety of patient care and the second an analysis of how the system is used in practice by nurses.

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