Implementing Best Practice Guidelines onto PDAs – Preliminary Results and Lessons Learned

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Abstract

Best Practice Guidelines (BPGs) represent a promising way to improve nursing care by reducing the time lag between research findings and subsequent changes in healthcare practices. Translating the currently paper-based BPGs into a portable, computer-based format is seen as an important step towards the widespread use of BPGs in nursing practice. In implementing the asthma BPG onto a PDA, we have discovered that the concept of an "algorithm" is distinctly different for nurses and for computer programmers. Our on-going development of the computer-based BPG is influenced by these insights into the dynamic and iterative process of nursing care.

1. Introduction

A commonly cited discrepancy exists between research on effective clinical nursing practice and the direct patient care provided by nurses [1-3]. The lag between dissemination of research findings and subsequent changes in healthcare practices has been suggested to be as long as 17 years, attributed in part to the lack of tools to promote the rapid adoption of best practices [4-6]. This paper describes an innovative project undertaken to support knowledge translation into clinical nursing practice through the development of handheld technology that will support nurses in making decisions based on the best available evidence.

Nurses are the largest group of point-of-care decision-makers in the healthcare system, and they are required to make clinical decisions that may have life and death consequences and provide clients with information about treatment options "in the moment". To ensure that these decisions are reflective of current, research-based standards of care, there is a general movement toward incorporating evidence based practice (EBP) in nursing. EBP has been introduced successfully into mainstream medical practice, but barriers to widespread adoption in nursing practice remain [7-9]. The extent to which a nurse in clinical practice is able to locate the best research evidence, evaluate the findings, and then create a plan of action based on these findings is highly suspect [9]. While the systematic process of research review and critique inherent in the development of clinical practice guidelines or consensus guidelines would seem a good fit for nursing, adoption has proven to be challenging.

2. Supporting Nursing Clinical Decision Making with Best Practice Guidelines

Clinical decision-making is an essential nursing skill that requires clinicians to think quickly and do so in ways that will foster optimal and safe client care. The recent focus on creating best practice guidelines (BPGs) holds the potential to advance nursing practice by enabling nurses to access the best evidence related to a given clinical situation. The Nursing Best Practice Guidelines Program initiated by the Registered Nurses Association of Ontario (RNAO) in 1999 bridges the gap between research and practice through the development of nursing practice guidelines that reflect sound evidence from multiple sources. BPGs are "systematically developed statements based on best available evidence to assist nurses, other health care providers, and patients to make decisions about patient care" [10, p91]. Each guideline is based on a review of the literature related to a specific clinical focus in nursing, often drawing in particular upon findings from systematic reviews and meta-analyses. Defined criteria form the basis for critical appraisal of research findings. When research evidence is not

available, expert opinion and consensus may be sought to develop recommendations. Qualitative research findings and patient experience are considered valuable sources of information in addition to traditional quantitative research findings.

BPGs are decision-making aids developed to support safe, competent, and ethical nursing practice and to reduce nurses' sole reliance on tradition or experience, while introducing new knowledge into clinical practice settings. BPGs support clinical decision-making within the context of client preferences, contextual factors, and the feasibility of implementing recommendations. However, BPGs (which may consist of more than 100 recommendations) are developed as paper-based protocols. In a paper-based format, there is the potential for limitations in the amount of data that may reasonably be included if the tool is to serve as a decision-making aid at the point of care, possibly resulting in gaps requiring users to revert back to familiar processes [11]. Including large numbers of recommendations increases the challenges associated with easily accessing relevant materials in the moment. Ultimately, barriers exist to the use of paper-based guidelines as a means of knowledge translation. Despite the promise they initially held for decreasing the research to practice gap, when BPGs are presented solely in a paper-based format, users may continue to experience challenges to implementation in the moment and at the point of care.

This pilot project implements a process in which a clinical algorithm based on the RNAO BPG *Promoting Control of Asthma* [12] is being developed and tested for use on a PDA. Translating the BPG into a format suitable for use in direct practice situations and accessible via handheld computer technology holds the potential to shorten the research-to-practice lag, assist with record keeping and patient care tracking, and enhance nursing clinical decision-making in the moment. Such an innovation, therefore, can be expected to improve patient care while supporting the full scope of nursing practice, thereby enhancing independent nursing practice, and improving patient outcomes.

3. Implementing BPGs as Algorithms

There is a large difference between the concept of an "algorithm" for nurses and for computer programmers. Algorithms are conceptually more "linear" in computer programs – there is a start point, an end point, and a series of tasks that are performed in a specific order in between. Within nursing, there are certain components of an assessment process that on the surface imply this linearity. However, that interpretation would be overly simplistic, failing to recognize the inherent nursing knowledge and creativity involved in all areas of practice, from clinical assessment to partnering with clients, shared decision-making, and implementation and subsequent evaluation of client-centred care. It also fails to recognize essential professional accountabilities embedded in nursing practice.

If, for example, one considers the *Promoting Control of Asthma* BPG [12], all adult patients should be assessed for asthma. If a patient reports that s/he coughs, wheezes, or has chest tightness more than three times per week, then s/he is indicating signs of possible uncontrolled asthma and further assessment is required. This part of the BPG looks like a standard "if – then" programming structure, and it has been implemented as shown in Figure 1a.

The BPG component shown in Figure 1a is implemented with the following logic – if any of the four checkboxes are selected, go to the "assess uncontrolled asthma" page when the OK button is pressed.

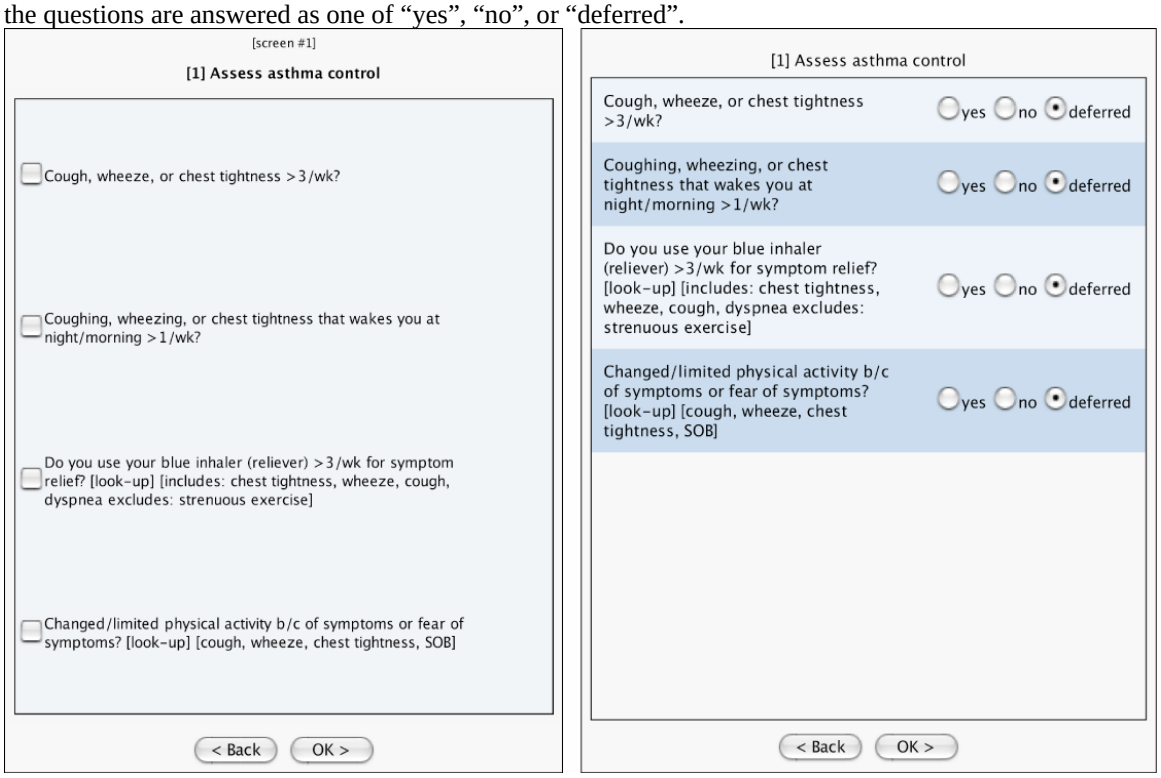
Diagnostically and logically, this is fine…but ethically and legally it is not. From a programming point of view, if an end-user understands the logic of the algorithm and is interested in making a quick assessment, then s/he might press "OK" after observing the first symptom – there is no change in the diagnosis for a patient who has just one symptom versus a patient who has all four of the listed symptoms.

However, if the algorithm records the remaining three symptoms as "symptom not present" rather than "assessment for symptom not performed", then this algorithmic implementation of the BPG will not have kept an accurate record of the user's actions (i.e., assessments made). The resulting inaccuracies would create a legal hazard for any nurse as an end-user since there cannot be room for "assumptions" of action or assessments. More importantly, the inaccuracies also create the potential for erroneous recording of information in a patient health record (i.e., "patient not assessed for symptom" does not in any way equate with "patient assessed, symptom not present"). Failure to ensure that an accurate record of assessments/findings is recorded would violate the fundamental standards of nursing practice, regardless of whether these assessments/findings have an effect on clinical decisions, patient care, or the subsequent screen that will appear on a computerized clinical tool.

The difference between Figure 1a and Figure 1b represents the difference between an operationalization of a nursing algorithm using programming logic but in the absence of the professional context of the end-user and the operationalization of a nursing algorithm in the context of the unique knowledge of the profession, as well as legal and ethical requirements for practice that nurses as end-users must meet. To create an accurate record with the first implementation (Figure 1a), the nurse would have to record her actions separately, and redundantly, on paper. This duplication of effort would make the PDA

implementation unviable in hospital practice. A redevelopment of the BPG program to implement "yes/no/assessment deferred" has instead been implemented to support all possible options in the situation. (See Figure 1b.)

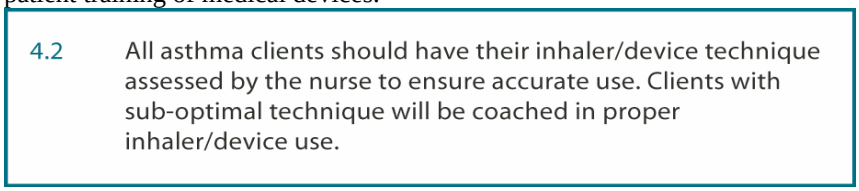
Figure 1 – Screen shots of the "assess asthma control" page on the PDA. On the left (Figure 1a), the questions are answered as "yes" (when checked) and "no" (when unchecked). On the right (Figure 1b), the questions are answered as one of "yes", "no", or "deferred".



With the ability to defer an item comes the necessity to be able to revisit that item. Unlike the more linear algorithms in computer programming, "algorithms" in nursing are implicitly more dynamic and flexible because they are essentially embedded in a practice that requires knowledge, skill, and judgment beyond that contained within the algorithm and because nurses partner with patients to mutually construct client-centred care that takes into account the need for flexibility and respect for patient preferences. Ultimately, from a programming perspective, each task in a BPG is more likely to require a "loop" rather than a "sequence".

Consider, for example, the patient education component of the asthma BPG related to medication administration devices and techniques (see Figure 2). The apparent logic for this BPG component is to select one device, provide education as indicated, and continue. However, there is an implicit possibility that a patient could require more than one type of medication administration device, so the program will have to loop back to the device selection menu until the nurse has been able to assess patient knowledge and provide appropriate education with respect to all of the required devices.

Figure 2 – Part 4.2 of the RNAO BPG *Promoting Control of Asthma* [12] covers patient training of medical devices.



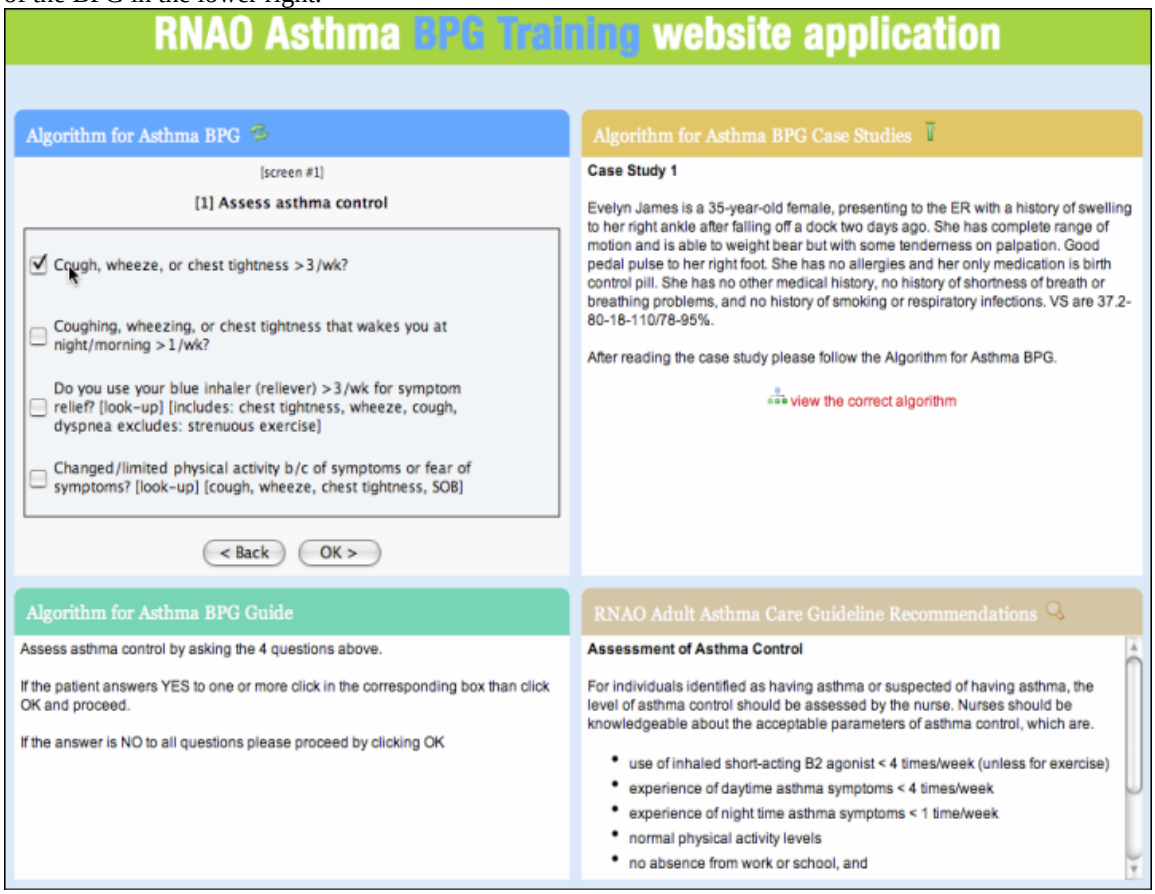
These are just two examples where the linearity in the BPG "algorithm" that was assumed for the program development did not exist. Unlike a fully automated algorithm that can lead anyone through the process (e.g. eHealth and self-diagnostic tools), a BPG behaves more like a series of cues, suggestions, and reminders that help an experienced nurse to leverage both her accumulated experience and new research findings. The process of using a BPG is much more iterative – there is a sequence of steps, but these steps can be exited from and re-entered into at any time.

4. Supporting Resources for Nurse Education

To make the programming tractable, a certain amount of linearity has been imposed upon the computer-based implementation of the BPG. The constraints involved with following this more linear process may be unnatural to nurses who have had more experience with the dynamic needs of patient-centred care. In addition to any technical training that nurses may potentially require to become familiarized with the computer/PDA interface, nurses may also benefit from support to learn the underlying processes of the computer-based BPG algorithm.

To develop an on-line module for nurse training, the Java-based implementation of the BPG on the PDA has been exploited. The programmed BPG can be converted quite easily into an applet, and this applet has been embedded into a learning object [13] (see Figure 3). The three additional pieces of the learning object are synchronized to the applet – whenever the BPG screen changes (e.g. when the nurse presses the OK button), the three side windows will update as well to contain material that is relevant to the new screen.

Figure 3 – Screen shot of the on-line learning object. The learning object has the BPG applet in the upper left, case studies for diagnostic practice in the upper right, a "help" page in the lower left, and an overview of the BPG in the lower right.



For example, a nurse can select a case study (from the upper right corner) to practice using the BPG as a diagnostic tool. Each case study lists a series of patient conditions and symptoms, and the nurse is then able to enter this information into the BPG as appropriate. Upon pressing the OK button, the case study window will update to the next set of symptoms and conditions that the nurse might observe, or to a page that indicates that the nurse has performed an analysis inconsistent with the available information (thus prompting him/her to go back to the previous page).

Throughout a case study or a freeform exploration of the BPG, the lower two windows will contain relevant information about the current BPG screen. In the lower left corner, there is a help page that describes the BPG from a more technical/ algorithmic perspective – e.g. if the patient has at least one of the six indicators of uncontrolled asthma, then proceed to an assessment of uncontrolled asthma; otherwise, with relation only to this singular assessment of asthma, the patient likely does not require urgent care. In the lower right corner, a description of the BPG from a more typical health-oriented perspective

will be presented – e.g. if the potential for uncontrolled asthma is identified, then the level of acuity needs to be assessed and appropriate action, including possibly medical referral, is indicated.

Initial feedback from a group of expert emergency nurses on the learning object has been quite positive. It uses a standard web interface, it is available to nurses on their own time, and it provides large amounts of user support and feedback. The success of the learning object makes strong implications on the future design of computer-based BPGs.

5. Computer-based BPGs

Based on size and portability, the selected platform for the BPG is a PDA – specifically, the Palm Tungsten IIe. As we continue through pilot testing the device, it will be important to consider not only the advances that this project holds in relation to promoting best nursing practices at the point of care, but also the potential limitations related to the chosen technology.

It is possible that the small screen size of the PDA may present challenges to quick and efficient utilization by nurses in a high-stress, nursing practice environment. In order to ensure that development of the practice tool occurs with ease of integration into everyday nursing practice in mind, attending to the concerns and experiences of end users is essential. Valuable questions, such as appropriate infection control practices in relation to the device, have arisen directly from the practice setting. Additionally, challenges associated with attempting to integrate the Palm PDA seamlessly with the patient record system (based on Windows XP) that is utilized at our partner hospital have emerged. Continued development and testing will focus on identifying strengths and weaknesses inherent in the selected technology.

6. Discussion

Best Practice Guidelines hold the promise of being able to shorten the research to practice lag, assist with record keeping and patient care tracking, and enhance nursing clinical decision-making in the moment. Building a computer-based support platform for the current paper-based BPGs is part of what is required to achieve this promise. In converting BPGs into computer programs and algorithms, an important difference between the concept of an “algorithm” for nurses and computer programmers was discovered.

The initial implementation of the computer-based BPG assumed and imposed too much “linearity” on the assessment and decision-making processes involved in providing nursing care. This linear process is not just unnatural for nurses, it is entirely contrary to the necessarily dynamic actions that a nurse must perform to provide ethical, competent, and safe patient-centred care. Further understanding of how best to support these dynamic and iterative actions is presented as a key step towards the development of practical, computer-based implementations of BPGs.

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