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A Precision Post-Operative Wellness Monitoring Solution

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Abstract

Multiple orthogonal challenges around escalating costs and providing quality care plague healthcare delivery, especially in OECD countries. This research in progress paper addresses the post-operative discharge phase of the patient journey and proffers a technology-enabled model that both supports a quality care experience post-discharge but also prudent management to minimise costly unplanned readmissions and thereby subscribe to a value-based care paradigm. The chosen context is stoma patients but the solution can be easily generalised to other contexts. Next steps include the conduct of clinical trials to establish proof of concept, validity and usability.

Keywords:

Patient Readmission, Patient-Centered Care, Patient Monitoring

Introduction

Given the challenges facing private healthcare today, there is an increasing pressure on private healthcare organisations to provide high value, high-quality patient-centred care across the acute-care continuum (Australian Commission on Safety and Quality in Healthcare 2010 [1]). While the recognition for the need of care delivery to be patient-centric is growing, the appropriateness of the approaches adopted to achieving this endeavour remains questionable [2].

An integral enabler is without question Information Technology (IT) solutions (see for example [3]). The limitation with many current systems is their limited coverage across the acute-care continuum [4], where both pre-admission and post-discharge phases are not seamlessly connected to the hospitalisation phase in the patient journey.

In Australia, as in other OECD countries, most notably the US, unplanned readmissions are now becoming more carefully scrutinised. In most instances in Australia, unplanned readmissions are considered to be readmissions for issues relating to the primary diagnosis within 28 days of the initial treatment for that primary diagnosis. We believe that it may be possible to reduce the number of unplanned readmission by developing a precision post discharge wellness monitoring solution and the following serve to outline this solution.

We select stoma patients as a pilot study for this solution because we note that based on hospital data gathered from a large not-for-profit tertiary institute in Melbourne, Australia a common and avoidable unplanned readmission relating to stoma patients is around lack of hydration. This is particularly problematic during the hot dry Australian summer months.

This study proposes a generic, open-source-based starting point for a customizable modeling, simulation and testing framework for mobile Patient Care Devices (PCDs) that can support relatively complex coordination of care for post-surgical patients. This system uses an architecture that can be modified to suit each patient's precise needs or widely differing clinical protocols. These tools allow simulation of expected ranges of safe and reliable performance, and can also be used to explore or simulate likely failure modes and potential safety or health risks due to communication system or staffing overload, errors, or other complications

Clinical Use Case

In order to provide proactive patient care post-discharge following stoma surgery, several remote medical devices can be employed. For example, elevated patient temperature or pulse can indicate an emerging infection at home which might easily and inexpensively be treated by early intervention with an appropriate antibiotic. High blood pressure and pulse might be an indicator of patient pain or discomfort, which might be initially treated with basic over-the-counter anti-inflammatory medications. Low blood pressure and elevated pulse might be predictors of dehydration, which might readily be treated by drinking more fluids and electrolytes. The stoma bag may also be monitored with simple sensors that keep track of filling and emptying rates, providing an indication of inadequate food and liquid intake.

In all cases, the monitored patient wellness parameters can be routed to a central patient homecare coordination team. The care coordination team can invoke appropriate rules and treatment actions. For example, a care coordinator could call the patient/family, provide remediation guidance, education, and/or prescriptions. If needed, a visiting nurse or physician could be dispatched to provide in-home care.

In addition, the monitors and the data monitoring systems can have an alarm and/or alert level triggers pre-set or remotely adjusted. Thus, if a low-grade fever appears to be emerging, the patient, family, or care coordination team could increase the temperature alarm by one degree, to notify them if/when the fever becomes more severe. Similarly, a high and low blood pressure alarm could be pre-established based on the patient's

discharge condition, in order to alert caregivers of unusual emerging risks.

Once a patient's physiological data is available to the care coordination system and team, clinical decision support algorithms and systems can be used to enhance, accelerate, and escalate emerging patient risks to staff who are appropriately trained to support high-quality, safe home care for discharged patients. Intervention at the home will usually be far less expensive than re-admission to the hospital, and care plan changes can often occur quickly. The care coordination team will be able to arrange emergency care or transport if home-care turns out to be inadequate for a specific patient situation.

Because many physiologic monitoring devices are now becoming rather inexpensive and ubiquitous, and they rely on consumer-grade internet or cellular communication channels, the incremental cost of deploying such systems is falling rapidly. In addition, many of these devices can be cleaned and re-used for subsequent patients.

In the following sections, we illustrate the system design and simulation of a flexible home-care monitoring and care coordination system. We identify representative monitoring devices, but the model is extensible. Additional monitoring devices and data can easily be added. e.g., in some cases, patient weight may be a valuable indicator of dehydration, or of congestive heart failure complications. Adding a patient scale and decision support rules is very easy with this system.

In addition, this system could easily be extended to include patient co-morbidities. For example, a severe industrial or automobile trauma patient could conceivably be sent home with both a stoma bag and a hip replacement. If that were the situation, additional physiologic channels may be added, such as gait and PT/exercise/mobility tracking and analysis.

Results and Discussions

The previous section has served to proffer an appropriate solution leveraging the capabilities of various technologies. The aim is to monitor patients as unobtrusively as possible so that alerts can be triggered to inform the designated healthcare professional if a trigger incident has occurred that should be addressed. In this way, the patient is able to navigate the post-discharge phase of their treatment effectively and efficiently and with the highest level of a positive patient and caregiver experience. In addition, by having alerts triggered no sooner a trigger situation arises, it is also possible to act as quickly as possible, thereby averting a more complicated, dangerous, and/or expensive problem further down the track. In this way, we believe we are addressing two critical objectives of healthcare delivery simultaneously; namely providing a high-quality patient experience as well as providing a high-value solution as we are trying to mitigate the need for unplanned readmissions by catching trigger situations as early as possible and then addressing them.

The next step is to run a two-arm non-blinded clinical trial to test the full benefits of the proposed solution. The control arm will continue to have patients exposed to standard practices around discharge and post-discharge follow up and monitoring while the intervention arm will focus on utilising the developed technology solution in addition to standard care practices around discharge and post-discharge. In particular, we plan to monitor levels of hydration, using triggers of blood pressure, pulse and weight to trigger levels going below an appropriate threshold. In addition, patients will receive via their mobile phones, education, reminders and other important information about maintaining appropriate levels of hydration. We focus on hydration as this has been identified as the singular most frequent reason for unplanned readmission with stoma patients at the chosen healthcare facility. We have secured ethics committee approval, and plan to run this trial as soon as final clinical post-discharge protocols are complete, validated, and approved and patient recruitment is complete.

Conclusions

This research in progress has served to proffer a solution to address the post-discharge phase of stoma patients. The proffered technology-enabled solution support both a high-quality patient experience as well as supporting a value-based care paradigm. We contend that such solutions are not just useful in the context as we have presented; i.e., stoma patients, but can be applied more generally so that the post-discharge phase of the patient journey is also monitored and managed, enabling both a high-quality patient experience as well as prudent management of likely trigger situations that may if not addressed lead to unplanned readmissions. Given the challenges faced by all OECD countries with respect to the exponential costs to provide quality care and the increasing pressures on healthcare organisations to deliver high quality and high-value care, we believe such technology solutions are strategic necessities and must be carefully considered. Our future work will focus on conducting clinical trials to establish the validity, usability and proof of concept of the proffered solution.

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References

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