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Dr Sarah Dods leads CSIROs research in health services delivery within their Digital Productivity and Services Flagship. In this role, Sarah leads multidisciplinary research teams focused on supporting the future sustainability of Australia's health system through evidence based digital services innovation to improve healthcare productivity, quality of care, and access to services for all Australians. Sarah has over 20 years experience in multidisciplinary innovation, including mining R&D, high-tech startups, and academia, spanning research and business roles. Her experience includes 13 years researching into future optical broadband networks, which are now becoming an everyday reality.

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Big insights into patient flow

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SUMMARY

Improving patient flow in hospitals is a significant challenge for any efforts across the globe aimed at addressing overcrowding, improving service delivery and preparing for the rising demand for healthcare. The complexity of the healthcare system however demands multiple improvements across the gamut of the health service to work together if sustained improvements in patient flow are to be delivered. Needing significant volumes of data from disparate sources ranging from hospital information systems to twitter feeds to be processed, often in real time, innovation in patient flow presents significant big data challenges but offers the opportunity to deliver significant benefits to the process. In this manuscript, we present our efforts to deliver improvements to patient flow across various areas of hospital service delivery and demonstrate how this distributed modular approach can help achieve organisational improvements to patient flow.

INTRODUCTION

The most visible challenge facing our healthcare system is overcrowding in hospitals, which has been labelled an 'international crisis'[1]. Overcrowding and long hospital waiting periods have a significant impact on the quality of patient care and patient experience. Our health services research team is helping hospitals meet performance targets recently introduced by the national health reform, whilst solving the challenge of overcrowding and system bottlenecks. In this manuscript, we provide an overview of the patient flow modelling research currently being undertaken and how our analytics, optimisation and operational decision support tools are working on patient flow solutions across hospitals to deliver big insights into this particularly big problem.

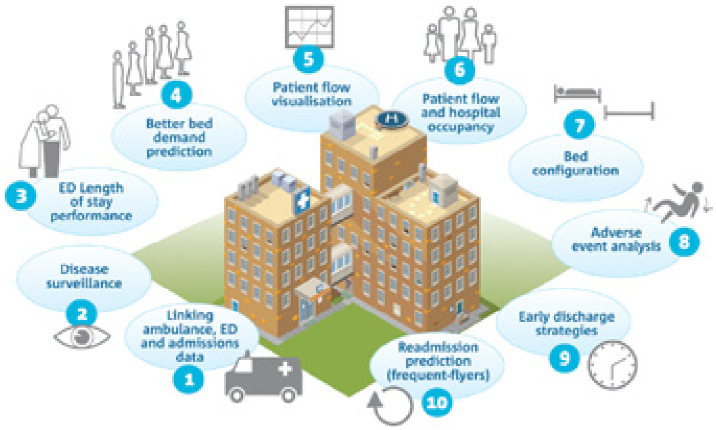

Figure 1. Big data analytics: supporting organisational improvements to patient flow

DESCRIPTION

In this section, we describe some of our key research efforts aimed at solving various patient flow problems across hospitals to show how the various solutions can fit together to provide big insights and deliver enterprise wide patient flow improvements.

Emergency departments (EDs) are critically overcrowded and struggle to respond to day-to-day arrivals. Contrary to conventional wisdom that emergency patient volumes are unpredictable, the number of admissions per day can be predicted with remarkable accuracy. We have developed the Patient Admission and Prediction Tool (PAPT)[2], that employs historical data to provide an accurate prediction of not only the expected patient load but their medical urgency and specialty, and how many will be admitted and discharged. Our PAPT platform allows hospital management to accurately forecast service demands for inpatient and ED beds, well in advance.

One topic of much recent controversy is “optimum occupancy,” or how close to 100% occupancy a hospital can operate at before service efficiency decreases. To help improve understanding of the effects of high occupancy we investigated inpatient and ED patient flow across Queensland public hospitals[3] and identified three stages of system performance decline, or choke points, as hospital occupancy increased. These were found to be dependent on hospital size, and reflected a system change from ‘business-as-usual’ to ‘crisis’. The results indicate that modern hospital systems can operate efficiently above the often-prescribed 85% occupancy level, with optimal levels dependent on the size of the hospital. With this information, hospitals can characterise their individual choke points and determine their optimal occupancy. They are then able to design strategies to better cope when the hospital reaches that occupancy.

Having the right mix of beds is critical for hospitals in maximising efficient service delivery and patient care. We have developed simulation models for patients admitted to inpatient beds from ED. These models can be used to assess how changing the numbers of beds in different specialties affects the waiting times for inpatient beds. The models have been used to determine the percentage of patients discharged within four hours from ED, for a fixed number of beds assigned to specialties in different combinations. The model can also automatically adjust allocation of beds between specialties to find the overall minimum number of beds needed in the hospital to achieve a specified performance.

There is much supposition and guesswork in understanding how hospital occupancy relates to patient safety and minimal hard evidence to date that higher inpatient occupancy equates to a higher likelihood of adverse events. We have explored this important issue through examining the relationship between daily hospital occupancy rates and the occurrence of reported adverse events[4]. The study confirmed that increased hospital occupancy does increase the reported rate of adverse events; in general, for a 10% increase in hospital occupancy, the percentage increase in the incident rate of all reported adverse events was around 20%. This is an important factor to consider in developing capacity management strategies.

A widely recommended strategy for improving patient flow in acute hospitals is to schedule patient discharges for earlier in the day. In the face of little evidence to support this suggestion, some clinicians have questioned the actual benefits of this strategy. We have investigated the effects of varying inpatient discharge timing on ED length of stay and hospital occupancy, to determine the ‘whole of hospital’ response to discharge timing. We also constructed simulations to model the impact on occupancy levels of shifting all discharges earlier or later[3], providing a tool for hospital staff to see the effect of early discharge.

Our other research projects in that space are focused on linking health data from disparate sources in a privacy preserving way, modeling and visualising health data, improving real time disease surveillance using innovative sources such as social media, and employing predictive analytics to reduce unplanned hospital readmissions and support hospital decision making. Hospital administrators thus have a range of solutions available to choose from when addressing patient flow challenges at a service level. Out PAPT solution is currently available to public hospitals across Queensland and is being used to proactively manage bed demand. Our other research, including occupancy analysis, bed planning simulations and early discharge solutions have been used at several Australian hospitals to drive policy and process reform and deliver sustained improvements to patient flow.

CONCLUSION

This abstract briefly touches on a number of the analyses that we have undertaken together with our hospital partners, and which are providing evidence based solutions to problems of overcrowding and bed capacity in hospitals. Bed demand may seem chaotic, but we have shown that hospital admissions are predictable when data techniques are applied properly to this complex system. Our models have provided information to hospitals to quantify the effect of early discharge on reducing peak occupancy, to show how having the right mix of specialty beds can reduce length of stay in emergency departments, and to show how understanding a hospital’s “chokepoint” can inform hospitals as to when to trigger “high occupancy” strategies, to provide a better degree of control. The insights gained from each of these analyses have helped with understanding others too, and together, these collaborative analyses are helping deliver big insights into improving patient flow in hospitals.

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