Infection management in critical care – personalised medicine and antimicrobial stewardship through a point-of-care decision support system

L.S.P. Moore¹, E. Charani¹, K. Murthy², P. Herrero², K. Hatzaras³, P. Georgiou², A.H. Holmes¹

¹Centre for Infection Prevention & Management, Imperial College, London, United Kingdom; ²Centre for Bio-Inspired Technology, Imperial College, London, United Kingdom; ³Health Management Group, Imperial College Business School, London, United Kingdom

Objectives: In critical care, infection management and antimicrobial stewardship is predominantly multidisciplinary with involvement of infection specialists being key. In practice antimicrobial prescribing frequently occurs out of hours, and when advice is dispensed by infection specialists, uptake can be variable. Current critical care patient management systems rarely integrate Decision Support Systems (DSS) to assist with this. Case Based Reasoning (CBR)-inspired software may provide an engineering solution to meet this need, through adaptive, heuristic algorithms drawn from archived patient cases to inform current medical decision making. We report here on the methodological process undertaken by a multidisciplinary team of healthcare professionals and engineers to develop a CBR-inspired DSS suitable for critical care infection management and antimicrobial prescribing, in the context of a multi-centre teaching hospital network in London.

Methods: The employed methodological process consisted of: requirements gathering; workflow modelling; medical decision making analysis from critical care and infection specialists; mapping of existing and required information systems; and finally, an adaptive software development process. Clinico-physiological and demographic parameters influencing infection management were categorised, and a definition of treatment success or failure was developed. Principle Component Analysis was used to reduce the dimensionality of the data through variable weighting. Graphical user interface development resulted in the final product being ported as an mHealth application (App) for use on mobile tablets. Iterative end-user focus groups were used to streamline data entry and functionality on these tablets. Information governance was assured through use of the App as a thin client, whereby no data is stored locally and all communication between the App and the central servers is within secure hospital firewalls.

Results: Pre-implementation requirements gathering demonstrated universal utilisation of mobile platforms in a professional capacity among healthcare professionals, with limited concerns over social aspects of their use at the bedside. Upon utilisation of the App, workflow modelling suggests a potential 40% reduction (62 hours per month to 37) in infection specialist time spent consulting in critical care. The introduction of the App has the potential for optimisation of critical care infection management practice through: education (during intensivist-infection specialist interactions), continuity (potential for point of care support for interpersonal communication) and a personalised medicine approach to infection prescribing (adaptation of evidence based medicine and national guidelines by (i) cohort level resistance data and (ii) patient level infection diagnostic results).

Conclusion: An unmet need exists around decision support for critical care infection management and antimicrobial prescribing. Having piloted this CBR-inspired point of care decision support system, future work will focus on a multi-centre critical care study to evaluate the effect on antimicrobial utilisation and the impact on bacterial antimicrobial resistance in this cohort.