

Showcase Hospitals Local Technology Review Report number 6

Smartphone application for antibiotic prescribing

Imperial College Healthcare 
NHS Trust

The National

Centre for Infection Prevention & Management

The Healthcare Associated Infections (HCAI) Technology Innovation Programme

The basic ways of preventing and reducing healthcare associated infections (HCAIs) are largely unchanged. New technologies and equipment can support HCAI prevention strategies by helping get things done differently, more swiftly or more reliably.

The Department of Health has funded the HCAI Technology Innovation Programme¹. The Programme aims to

- Speed up the development and adoption of technologies to further help combat HCAIs
- Identify which new technologies provide the best value and will have the most impact

The Showcase Hospitals Programme

As part of the HCAI Technology Innovation Programme, Showcase Hospitals undertook local technology reviews of infection related products or technologies in which they have a specific interest. These are service evaluations, as defined by the Health Research Authority's National Research Ethics Service, and therefore do not require Research Ethics Committee review². This service evaluation was undertaken in Imperial College Healthcare NHS Trust.

¹ For further information on the Programme see <http://www.hcai.dh.gov.uk>

² See leaflet on defining research at <http://www.nres.nhs.uk/news-and-publications/publications/general-publications/>

Acknowledgements

This work was supported by the National Institute for Health Research Biomedical Research Centre Funding Scheme at Imperial College and the National Centre for Infection Prevention and Management (CIPM) funded by the United Kingdom Clinical Research Council (UKCRC).

Showcase Hospitals report number

Smartphone application for antibiotic prescribing

Contents

Executive summary	2
Introduction	3
The problem	
Antibiotic Prescribing	3
The product	3
The knowledge base	
What was known before this evaluation	4
Development and Implementation	
Introduction	4
Pre-development questionnaire	4
Application development	5
Launch and dissemination of the application	5
How acceptable was the application to staff?	5
Post-intervention additional functionality	6
National and local awards	6
Further development of the application	6
Advice for trusts considering introducing smartphone applications for the dissemination of policy and guidance	7
Cost comparison	7
Appendix 1 Pre-development Questionnaire	8
References	9

Executive summary

As part of the Department of Health's Healthcare Associated Infections (HCAI) Technology Innovation Programme, Showcase Hospitals undertook local technology reviews of infection related products or technologies in which they have a specific interest. The objective is to help Directors of Infection Prevention and Control and other stakeholders to decide whether they should consider any of these products or technologies as part of their Trust's strategy to reduce Healthcare Associated Infections.

The National Centre for Infection Prevention and Management (CIPM) and Imperial College Healthcare NHS Trust developed and implemented a clinical decision support smartphone application based on the Trust's antibiotic prescribing Policy. This work was part-funded by the Showcase Hospitals programme and this report summarises the steps in the development and implementation process and key learning points for other organisations considering adopting similar technologies.

CIPM worked in collaboration with an external developer to design a smartphone application in partnership with a team of researchers and clinicians at the Trust. The application is now widely adopted by clinicians and has received national interest and recognition winning both a national and local award.

Keywords: antibiotic policy, smart phone application, eHealth

Introduction

This report describes the development and implementation in Imperial College Healthcare NHS Trust, one of nine Showcase Hospitals, and the National Centre for Infection Prevention and Management (CIPM) of a smartphone application for the Trust's antibiotic prescribing policy.

The objective of this document is to help Directors of Infection Prevention and Control and other staff to decide whether they should consider using smartphone technology as a means of disseminating policy and guidelines in order to improve practice at point of care. It aims to highlight the potential for using the existing infrastructure of mobile technology for cost-effective point of care access to medical information and policy.

The problem: Antibiotic prescribing

Antibiotic prescribing is a High Impact Intervention³, and the 'need to get it right' is essential not only in terms of successful treatment of the individual patient but to prevent the unwanted consequences of treatment failure, toxicity, emergence of *Clostridium difficile* disease and antibiotic resistance. The majority of antibiotic prescribing is undertaken by junior doctors not specialised in the treatment of infections. The quality of prescribing may suffer as, in order to ensure effective therapy and to cover the gaps that exist in their own knowledge, prescribers use broad spectrum agents for longer than necessary^[1]. This sub-optimal prescribing decision process has resulted in widespread inappropriate use of antibiotics. The majority of prescribing errors in hospitals involve antibiotics^[2] and it is estimated that up to 50% of antibiotic prescribing in acute care may be inappropriate^[3]. Clinical decision support tools for antibiotic prescribing need to be developed to support prescribers at the point of care.^[4] Evidence-based science should be used in conjunction with modern technology to make the most desired action the easiest to follow for prescribers.

The product

The CIPM commissioned an external software developer to work with CIPM researchers and clinicians to develop a smartphone application which would act as a mobile point of reference for evidence-based local antibiotic prescribing, with an incorporated decision support system to assist clinicians in delivering optimised antibiotic prescribing and effective monitoring.

The Imperial Antibiotic Prescribing Policy (IAPP) smartphone application was developed in iterative stages. The final IAPP product was a mobile iteration of the Trust's Treatment of Infection Policy (TOIP) pocket guide with additional

³ High Impact Interventions (HII) are an evidence-based approach that relate to key clinical procedures or care processes that can reduce the risk of infection if performed appropriately. See <http://hcai.dh.gov.uk/whatooido/high-impact-interventions/>

functionality including therapeutic drug monitoring and clinical calculators such as those for creatinine clearance, ideal and obese body weight dosing.

The knowledge base

What was known before this evaluation

Smartphones (iPhones, Android) make up a significant proportion of mobile phones used by individuals. Healthcare professionals are extremely mobile and rely on their phones for communication and therefore it is likely that they will have access to them at all times during their working day.

Smartphone technology is increasingly being used to provide point of care information to healthcare professionals. To date the majority of clinical applications are commercial and provide empirical advice and information. There is a gap in utilising this technology to provide up-to-date evidence-based advice based on local policy and guidelines to clinicians in a device that they have access to at the point of care, thereby making it more likely that local policy will be referred and adhered to.

Smartphones provide an ideal channel of communication with staff, specifically in light of the relaxed restrictions around the use of telecommunication devices in medical environments.

Development and Implementation

Introduction

The Imperial College Healthcare NHS Trust TOIP is available to staff as a pocket guide, posters and on the intranet. The policy is promoted through induction training sessions with new intakes of doctors and also via local teaching sessions. This study was intended to see whether a smartphone application would be a feasible and useful addition to the ways in which the policy is made available amongst staff.

The development process was in stages and involved input from end users. The first step was to see whether relevant staff had access to smartphones at work. This was followed by a series of prototypes that were tested amongst end users to inform the final product.

Pre-development questionnaire

A questionnaire (Appendix 1) was devised and disseminated to junior doctors via the post-graduate teaching centres of Charing Cross, Hammersmith and St Mary's Hospitals. Pharmacists were sent the questionnaires via trust email and nurses were also selectively interviewed using the questionnaire on the wards.

Of 93 questionnaires returned, 80% of respondents (69/86), used a smartphone at work, with 90% of doctors indicating that they used either an iPhone or Android device (62/69).

Application development

The application was developed by clinicians for clinicians, in iterative stages. Senior and junior clinicians and pharmacists were involved in the design process through a series of meetings and focus groups.

Feedback received from focus groups was very positive, and many of the suggestions from the survey and testing phases were incorporated into the final product. For example, the final application included calculators for creatinine clearance and obese dosing weight for aminoglycosides; in addition, the application is fully searchable by drug and disease.

Further evaluation of the product was carried out post implementation, with staff encouraged to provide feedback on the application and its functionality after 15 sessions of use. The application will undergo continual revisions post implementation to ensure it is kept up-to-date and evidence based and to ensure the optimal use of technology. There will be an up to date analytics mechanism in place to provide information on the number of downloads and usage/ session of the application⁴.

Launch and dissemination of the application

The IAPP was launched in August 2011, to coincide with the new intake of doctors. As part of a multi-modal dissemination strategy the IAPP was promoted, 1) during the pharmacy teaching sessions for junior doctors in the post-graduate centres on all three sites; 2) in an email sent to all new doctors in the Trust; 3) on the intranet homepage that appears each time the internet browser is opened on a Trust computer; 4) in the Trust paper publication. In each case, potential users were provided with 'on the spot' information on how to download the application on their smartphones.

How acceptable was the application to staff?

The post-intervention questionnaire provided feedback and usage statistics. Of those who provided their opinion on the ease of use of the IAPP, 83% (25/30) found it 'easy' or 'very easy' to use. Clinical decision support features such as patient group specific prescribing advice e.g. elderly/frail and penicillin allergy were identified as features most appealing to the end-user. 85% (22/26) considered that the IAPP added to their knowledge base regarding antimicrobial prescribing, 96% (23/24) found that using it influenced their antimicrobial prescribing practice, with 70% (18/26) stating that the inbuilt calculators influenced their antimicrobial prescribing practice.

Clinicians were asked for their views on whether they would feel comfortable using the IAPP on their smartphones in front of patients. Of those who responded (n=35), 37% (13/35) noted that they were comfortable with using it on their smartphones in front of patients with the remainder (22/35) noting that they would either not feel comfortable or that their use of the IAPP would

⁴ Available from Flurry Analytics <http://www.flurry.com>

depend on the circumstances. The main reasons for reluctance of use of smartphone applications in front of patients was that it would look 'unprofessional' and was 'not allowed'.

Respondents were asked to suggest additional features that would make the first version of the IAPP more appealing. Suggested improvements were to include separate existing local antibiotic prescribing policies for specific specialties e.g. haematology and renal medicine and paediatrics all of which is under development. Improved accessibility to the policy was a recurrent theme from these interviews. In particular doctors identified the desirability of having a point of care, portable version of the policy as the pocket guides were liable to being misplaced or not always readily available.

An 'information' button directs users to an email address for assistance with downloads and feedback. Users have used the email to provide positive feedback on the application.

Post intervention additional functionality

Work is now under way to build on this application and develop the functionality. With the publication of the Department of Health Start Smart Then Focus guidance on antimicrobial stewardship,^[5] the application has been updated to specifically support this initiative.

The CIPM is now conducting a study investigating the impact of using this technology to improve patient outcomes.

National and local awards

The IAPP has received a national prize, the United Kingdom Clinical Antimicrobial Pharmacist Association's annual Novartis award for pharmacy practice and was a winner in the individual category for the Imperial College Healthcare NHS Trust Outstanding Service Care and Research Awards (OSC&RS).

Further development of the application

The CIPM have been successful in securing a grant under the Imperial College faculties of Medicine and Engineering collaborative to fund further work on using smartphone technology to deliver point of care support for improving patient quality of care. The successful application focuses on a pilot project to investigate the efficacy of using a smartphone application to run a novel decision support system (DSS) aimed at providing point of care clinical and local laboratory data to clinicians to support antibiotic prescribing. The DSS will be based on Case-Based Reasoning (CBR), a consolidated artificial intelligence technique, which has been extensively applied in medicine and solves newly encountered problems by applying solutions learned from solving problems encountered in the past in a similar way to which a human might solve the problem.

Advice for trusts considering introducing smartphone applications for the dissemination of policy and guidelines

Any organisation wishing to develop smartphone applications to be hosted on Apple devices needs to acquire an Apple developer license.

Strategic stakeholder engagement is required from relevant departments responsible for the policy, in this case Infection Prevention and Control (IP&C), Pharmacy, Information Technology departments and Communications teams.

Any trust wanting to use applications must first make sure the relevant infrastructure is in place. A key issue recognised was the need for IT infrastructure to support the application locally within the trust. The NHS Litigation Authority requests that any applications from the NHS containing medical advice that are made available via the iTunes store are covered by an appropriate insurance policy. Currently this amounts to £2000 p/a insurance for up to 7 years after the last download of the application. Due to this it was deemed inappropriate to provide access to the application on the Apple General Store. To address this issue two options were explored: 1) to host the application on the website of the developers 2) to host it on the website of Imperial College Healthcare NHS Trust. This application was hosted externally. The final application in this report was less than 20MB and did not require wi-fi connection for download. Password protection should be considered for the application upon download as well as any disclaimer advice for other NHS Trust accessing any Trust specific guidance.

Cost comparison

There may be internal costs to have policies and guidelines updated and the trust will be responsible for the accuracy and completeness of this information and documents provided to software designers assisting in the development of smartphone applications.

The cost of the iPhone application design, development and related services for this particular project were sourced with an external company who liaised with the CIPM in developing the graphical design and user interface of the smartphone application. This cost will vary between providers. Overall, when compared with the pocket guide, the application cost less to develop. Other cost benefits include the environmental benefits of less paper use as well as cost associated with design and graphics work for printed pocket guide and posters.

Appendix 1 Pre-development Questionnaire

Smartphone application for Imperial College Healthcare NHS Trust Adult Treatment of Infection policy (TOIP)

Project aim: To develop an application for the smartphones which helps healthcare professionals by providing accessible and up to date information on the Trust's TOIP at the point of prescribing.

Please tick the relevant box and/or provide answers in space provided for each question as required.

Q1.

i. Please specify your profession

Doctor Nurse Pharmacist Other.....

ii. If other please specify.....

iii. Professional grade.....

iv. Speciality.....

Q2.

i. Are you aware of the Imperial College Healthcare Trust - Adult Treatment of Infection Policy (TOIP)?

Yes OR No

ii. Are you aware of the

TOIP pocket guide? Yes OR No

TOIP poster? Yes OR No

Q3.

i. Do you refer to the

TOIP Pocket guide? Yes OR No

TOIP via Imperial Intranet Yes OR No

TOIP poster Yes OR No

If you have answered 'Yes' to any of the above go to Q4, otherwise go to Q5

Q4.

How often do you refer to the TOIP when prescribing/administering/monitoring anti-infectives?

Most days 1-3 x /wk < 1/wk

Rarely Never

Go to Q6

Thank you for your input.

Q5.

Can you provide a reason why you do not use the TOIP when prescribing/administering/monitoring anti-infectives?

.....

Q6.

Could you please suggest ways in which the TOIP can be improved?

.....

Go to Q7

Q7.

I use one of the following smartphones at work?

i-Phone Yes OR No

Android device Yes OR No

Nokia/Palm / Blackberry Yes OR No

If 'Yes' go to Q8

If 'No' finish questionnaire

Q8.

Do you use medical/clinical apps on your smartphone as part of your daily work?

Yes OR No

Go to Q9

Q9.

Would you use the TOIP Policy booklet if it was made available as an app for use on your Smartphone?

Yes OR No OR Depends

Go to Q10

Q10.

What features would make a TOIP appeal to you?

.....

References

1. Dunagan WC, Woodward RS, Medoff G, et al. Antimicrobial misuse in patients with positive blood cultures. *Am J Med* 1989;87(3):253-9.
2. Lewis P, Dornan T, Taylor D, Tully M, Wass V, Ashcroft D. Prevalence, incidence and nature of prescribing errors in hospital inpatients. *Drug Safety*. 2009;32:379-389.
3. Davey P, Brown E, Fenelon, L, Finch R, Gould I, Hartman G, Holmes A, Ramsay C, Taylor E, Wilcox M, Wiffen PJ. Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database of Systematic Reviews* **2005**, Issue 4. Art. No.: CD003543. DOI: 10.1002/14651858.CD003543.pub2.
4. Charani E, Cooke J and Holmes A. Antibiotic Stewardship Programmes – what’s missing? *J Antimicrob Chemother* 2010 Nov;65(11):2275-7.
5. Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection. *Antimicrobial Stewardship: “Start Smart – then Focus”* Department of Health. November 2011.