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Games for Health 2014

Proceedings of the 4th conference on gaming and playful interaction in healthcare

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Preface

The Fourth European Games for Health Conference 2014 (GFHEU 2014) brings together researchers, medical professionals and game developers to share information about the impact of games, playful interaction and game technologies on health, health care and health policy. Over two days, more than 500 attendees will participate, in over 13 sessions provided by an international array of more than 50 speakers, cutting across a wide range of activities in health and well-being. Conference topics include exergaming, physical therapy, disease management, health behaviour change, biofeedback, scientific validation, rehab, epidemiology, training, cognitive health, nutrition and education.

As we are aiming for innovation and further integration of research and game development in health care, this year we continued to add an extra academic track to the conference. These proceedings are the outcome of that integration and contain 20 full papers presented at the conference in the form of oral presentations or posters. In this volume we have opted for not breaking down the papers into separate chapters. Our previous experience has taught us that such divisions are always a bit artificial, and so much more when dealing with health games. The academic track is interwoven into the conference's broader structure to further promote dialogue between academics and practitioners working within the fields of Game & Play Studies, Design Research, Game Development and the Medical Community, exploring and innovating within the greater area of health. This track is labelled 'Share your Research' in your conference program.

Yet, looking over the works submitted to this volume, few interesting trends are discerned.

Social relatedness and empowerment of the (end) user

Not always following the predominately-paternalistic approach, health games aim to facilitate self-efficacy and allow people to take charge of their own health and wellbeing. Designers and doctors join together to empower the patients like never before. Games are not only regarded as products (applications) but also as services for a longstanding relationship between patients, doctors, relatives and care providers or between medical doctors and students, to learn the practice of medicine. Several papers in these proceedings address motivational issues and meaningful (adaptive) feedback to facilitate these longstanding relationships. Moreover it becomes practice to integrate the game, app or applied toy in already existing forms of therapy, educational practices or other application domains. Using the gaming's affinity with social play and the rising spreadibility of media over social networking sites, the focus shifts from top-down to bottom-up and more participatory healthcare.

Theory and educational practice.

The theory of games for health in health care settings is also gaining traction, such as modelling patients behaviour in clinical immersive environments targeting at medical education or the theoretical underpinning of exergames. Perhaps even more

important is to study the public acceptance of these applications, allowing the game designer to anticipate in the design of even better appreciated games and play experiences. A clear trend, happily supported by the Games4Health conference, is the increase of number of games used in professional education of medical doctors.

Game mechanics, architecture and data.

Digital games allow players to use advanced computational power, (haptic) devices, consoles, wearable's, visualization, persuasive technology and create immersive environments. Using the Oculus Rift in games for pain management is a good example, but also adaptive games that take into account the abilities of the individual players. As health games become further embedded in the toolsets of caretakers and patients alike, a call for standardization and new architectures arises. Whether in the form of building rigid data structures to share between platforms, or more particular recommendations for world-builders, the call for agreed frameworks is out there.

Validation.

As always, validation is a hot topic, but perhaps an interesting trend is emerging in coupling validation with design theory. No longer based on traditional validation techniques originating purely in the medical domain, validation through design is the next thing. Which means that a therapy, cure or rehabilitation can be validated on its effect but also can be used to evaluate and deepen the design (theory of) the game mechanics.

In view of this all, the GFHEU 2014 proceedings can be considered as a timely document that provides many new results and insights in the new field of Games for Health. We would like to thank all members of the Program Committee for their most valuable and highly appreciated contribution to the conference by reading submissions, writing reviews, and participating in the discussion phase. We hope to provide you with many pleasant and fruitful reading hours.

August 2014
Amsterdam

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"On call: antibiotics"- development and evaluation of a serious antimicrobial prescribing game for hospital care

Enrique Castro-Sánchez[1], Esmita Charani[1], Luke SP Moore[1], Myriam Gharbi[1], and Alison H Holmes[1]

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Abstract: Improved antimicrobial prescribing is a key effort to reduce the impact of increasing antimicrobial resistance. Quality improvement programmes in antimicrobial prescribing have to ensure the continued engagement of prescribers with optimal prescribing behaviours. Serious games have been proposed to improve clinical practice and may serve to resolve some of the behavioural and social barriers influencing prescribing. We describe here the ongoing development and future evaluation of a mobile device-based serious antimicrobial prescribing game for hospital clinicians.

Keywords: antimicrobial prescribing, antimicrobial stewardship, serious game, gamification

1 Introduction

Increasing antimicrobial resistance has been identified as a global threat to health [1]. Antimicrobial stewardship, or the prudent use of antimicrobials, has been advocated to arrest the advance of resistance [2]. A variety of antimicrobial stewardship measures have been implemented with varying success rates to improve the quality of antimicrobial prescribing. Whilst prescriber knowledge and skills are important, attention to behavioural and social aspects in prescribing appear equally essential to sustain improvement initiatives [3]. Serious games have been used to provide effective interactive learning and practice in surgery [4], as well as for undergraduate medical education [5]. The use of psychological techniques used in games ('gamification') has also been successfully introduced in other clinical settings to maintain clinicians' commitment to desired behaviours [6], prolonging the sustainability of quality improvement programmes and resolving some of the issues related to engagement affecting traditional intervention. The National Centre for Infection Prevention and Management (CIPM) at Imperial College London had previously developed successful smartphone apps focused on local antibiotic prescribing policies, highlighting the potential for electronic and mobile technologies to fill the gap between information provision and behaviour change [7].

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2 Objectives

We proposed the development of a serious prescribing game for computers and portable devices to support and encourage the prudent use of antimicrobials in hospitals prescribers. The development and evaluation of the serious prescribing game was our primary objective. Additionally, exploring the uptake, acceptability, and utility of the game as a tool to modify the behaviour of prescribing clinicians were some of the secondary objectives.

3 Materials and methods

The game is powered by a Unity game engine (Unity Technologies, USA), allowing for portability and multiplatform compatibility. Thus, the current game build can be installed and played in PC and Mac computers, as well as Android and iOS smartphone and tablet devices. We endeavoured to develop a product with light system requirements, in view of the potential for deployment and use in low- and middle-income countries.

3.1 Clinical elements

A series of virtual patients (Figure 1) were prepared in collaboration with commercial game developers, designers and clinicians (including doctors, pharmacists and nurses). These cases allowed clinicians to practice prescribing behaviours in a simulated environment, understanding the steps involved in the prescribing process and gaining a comprehensive overview of their professional role and the impact of antimicrobial prescribing decisions in diverse patient outcomes.

We prepared a list of clinical signs and symptoms, laboratory tests and imaging results related to different infectious pathologies. The ~120 cases included community- and healthcare-acquired pneumonia, viral and bacterial meningitis, urinary tract infection, influenza, cellulitis and *C. difficile* colitis, among others. The game provided players with clinical information about each patient gradually to help them decide the diagnosis and management for the case. Clinicians could opt to prescribe oral antibiotics, broad- or narrow-spectrum intravenous (IV) antibiotics, request further tests or discharge the patient without any treatment. In an attempt to replicate decision-making in real life, we developed a scoring algorithm that rewarded timely and accurate diagnosis and management and penalised rushed or delayed decisions. Delayed consequences of some prescribing choices were also made explicit to players using re-attending cases. For example, using IV antibiotics too frequently results in patients returning with cannula-site infections, thus increasing clinicians' workload. Likewise, the excessive use of broad-spectrum antibiotics will also lead to cases complaining of antibiotic-associated diarrhoea.

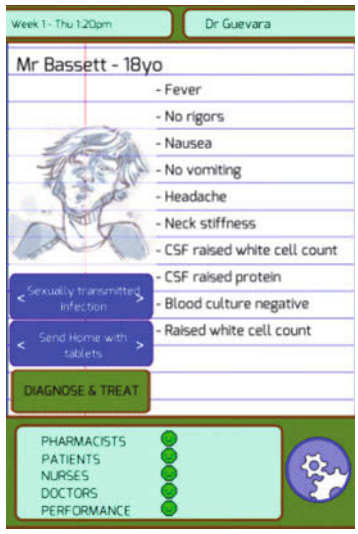

Fig. 1. Virtual patient with clinical symptoms and diagnosing options

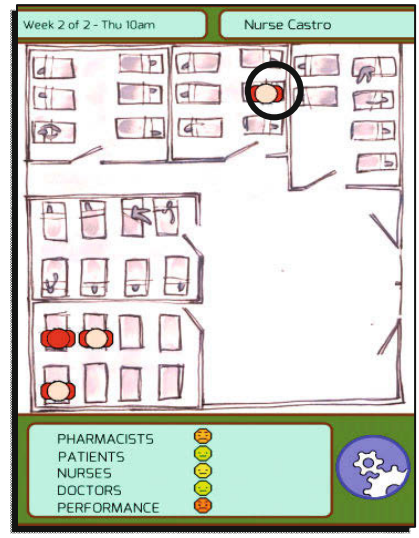

Fig. 2. Gamification elements including timers, personalization, scores and multiple simultaneous cases

3.2 Gamification elements

Different features incorporated in the user interface promote constant interaction with the game. For example, personalization with players' name or the use of timers and scores encourage a continued engagement. The increasing case difficulty also contributes to sustained commitment to desired behaviours. Figure 2 illustrates the game mechanics and specific features included to focus players' mind on desired antimicrobial prescribing behaviours and to highlight unintended consequences.

Immediate feedback on performance is provided after each case and at key interim time points during the game (Figure 3). Such feedback fuses diagnostic accuracy and the impact of therapeutic decisions on other professionals and the wider hospital environment. Future versions of the game will allow players to print off their feedback and reports for inclusion in their professional portfolios; however, further work is required to generate evidence about the usefulness of this aspect of the game.

Additionally, behavioural nudges and messages are offered by peers and other professionals, patients, hospital management and governmental quality assurance inspectors, depending on each player's performance (Figure 4). Whilst these nudges have a humorous tone, they provide information about not only antimicrobial prescribing but also other associated patient safety behaviours such as hand hygiene or intravenous catheter use.

Other classic elements of gamification such as competition and social networking components could be incorporated in future iterations of the game. For example, individual players as well as clinical teams performance may be published (with their agreement) in a ranking, in addition to social networks.

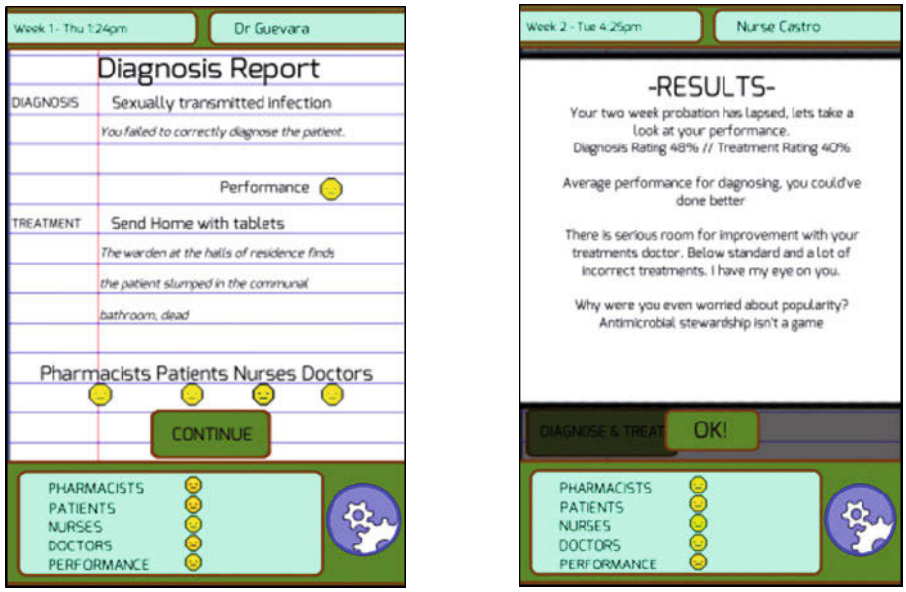

Fig. 3. Feedback following management of a case (left) and interim performance report (right)

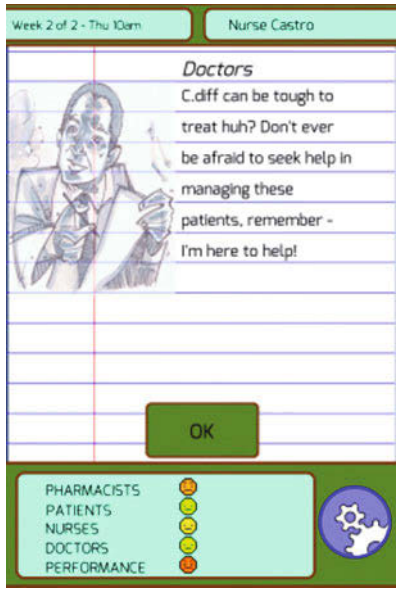

Fig. 4. Behavioural nudge provided by peer doctor

4 Evaluation

We propose to evaluate the game by combining qualitative and quantitative methodologies supplemented by in-game metrics.

4.1 Qualitative approaches

Players will be invited to participate in semi-structured interviews to explore their perceptions and opinions about using the game, and to discover whether they feel their practice may have changed. The qualitative, reflective methodology would also help identify any facilitating factors or barriers for engagement, as well as unintended effects. For example, a high level of playtime may reflect an elevated interest or an excellent response to the gamification elements included, but may, on the other hand, impact on the productivity of the participants.

4.2 Quantitative approaches

Two randomised controlled trials will provide information about the efficacy of the game. The first trial will be carried out amongst junior doctors starting their clinical rotations in our hospital organizations. The doctors recruited in this four-arm study will be randomised to receive either 1) a conventional educational session on antimicrobial prescribing, 2) a smartphone game unrelated to antimicrobial prescribing, 3) the serious antimicrobial prescribing game, or 4) the combination of educational session plus the serious antimicrobial prescribing game.

We will use vignettes with clinical scenarios to assess the knowledge, confidence and decision making of the participants on enrolment as well as at defined time points during the study period. Naturally, we would expect participants allocated to receive the educational package to obtain better results in the clinical vignettes requiring more or better knowledge of antimicrobials. However, participants using the prescribing game should, on the other hand, perform optimally in the behavioural vignettes.

The second trial will target 4th-year medical students and will utilise a modified version of the game to explore if those students randomised to receive the game achieve better scores in the end-of-year Prescribing Safety Assessment (PSA), a national exam jointly developed by the British Pharmacological Society and the Medical Schools Council to elicit competencies in relation to safe and effective use of medicines.

4.3 In-game metrics

Multiple parameters during gameplay are collected and transferred to an external database, using unique identifiers for each participant. From broader metrics such as engagement with the game or duration of each encounter, to the exact time required for participants to resolve each case and the diagnostic and therapeutic decisions made, or the influence of prompts and nudges on prescriber's decisions by the differ-

ent characters (doctors, nurses, pharmacists, hospital managers) can be extracted and mapped. Potentially, we could identify favourable dose-effect relations i.e. whether increased gameplay time greatly improves prescribing decisions).

5 Discussion

Hitherto serious digital games in medical education, surgery and infection prevention and control have concentrated on providing technical knowledge or increasing manual dexterity. However, the ongoing initiative described here aims to influence prescribing behaviours amongst hospital doctors. The ubiquity of smartphone devices in our clinical setting, the increasing computing power of such devices, and the success of previous smartphone-based initiatives in our organization encouraged us to develop a serious antimicrobial prescribing game. Moreover, the psychological techniques and mechanisms frequently used in games, broadly identified as gamification, may resolve the difficulties associated with sustained engagement in behaviour change strategies.

The relative ease by which new cases can be added to the game engine allows for multiple possibilities. It would be possible to produce versions of the game tailored to particular clinical areas (i.e. immunodeficiency, paediatrics or tropical medicine), as well as settings with limited availability of antimicrobials. Furthermore, the game could be promptly modified to be useful in the learning of optimal behaviours in emerging infections such as Ebola.

6 Conclusions

Sustaining appropriate prescribing behaviours remains a challenge for antimicrobial stewardship actions worldwide. Serious games delivered on mobile devices can complement the experiential learning of prescribers. Games can be useful to reinforce desired behaviours, elicit the relationships between different professional groups involved in prescribing decision-making, and highlight any unintended consequences of antimicrobial prescribing. Serious games may be an affordable and feasible solution to address the behavioural and social influences on prescribing.

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Virtual Reality and *Mobius Floe*: Cognitive Distraction as Non-Pharmacological Analgesic for Pain Management

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Abstract. This paper outlines the intentions and current design behind the production of *Mobius Floe*, an immersive virtual reality game catered to acute and chronic pain patients. Researchers have shown that immersive virtual reality (VR) can serve as a non-pharmacological analgesic by inducing cognitive distraction in acute pain patients [Hoffman 2000]. *Mobius Floe* experiments with virtual reality as well as auditory immersion, a more experimental approach to cognitive distraction for pain relief; the results will be tested by acute as well as chronic pain patients to determine if chronic sufferers can benefit from similar VR practices as their acute counterparts. *Mobius Floe's* game design is informed by contemporary game design theory and cognitive psychology in order to improve its distractive properties.

Keywords. Chronic pain, acute pain, pain management, serious game design, health games, analgesia, virtual reality, cognitive load

1 Introduction

Virtual reality (VR) applications have yet to become a widely accepted complementary method to analgesics to reduce the perception of pain despite documented instances of its success. *SnowWorld*, a VR game with accompanying head mounted display (HMD) has demonstrated that VR treatments can work in tandem with pain medications to further reduce perceived instances of pain in patients with combat-related burn injuries [8]. Virtual reality has also been used to help combat other types of discomfort such as acute pain from dental procedures [6]. There is already evidence to suggest that chronic pain patients can benefit from immersive virtual reality applications [10]. Chronic pain patients, although requiring long-term pain reduction strategies, also suffer from shorter-term spikes in pain intensity [1] of which they may also benefit from non-pharmacological treatment practices suiting acute pain patients. *Mobius Floe*, the immersive VR discussed in this paper aims to expand upon non-pharmacological analgesic research for acute and chronic pain patients by improving the quality and variability of the distractive gameplay of its predecessors while introducing new forms of gameplay to examine, evaluate and compare to the field. Tasks involving cognitive

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