Virtual worlds to support patient group communication? A questionnaire study investigating potential for virtual world focus group use by respiratory patients

Michael J. Taylor, Dave Taylor, Ivo Vlaev and Sarah Elkin

Michael J. Taylor is an Honorary Research Associate at the Imperial College London Department of Surgery and Cancer and is in the second year of a medical degree at the University of Nottingham. He has completed a PhD, which was sponsored by CLAHRC for North West London, investigating how virtual worlds can be used to enhance collaboration and engagement in care. His other research work includes investigations of efficacy of behaviour-change techniques in facilitating obesity interventions. Dave Taylor is the Programme Lead for Virtual Worlds and Medical Media at Imperial College London, working to extend the applications of new media to many areas of healthcare research. With skills in virtual worlds, mHealth, application software (“app”) development, serious games, human interface design, project management and a commercial background in product development and marketing. Ivo Vlaev is Professor of Behavioural Science at Warwick Business School. He received a DPhil (PhD) in Experimental Psychology from the University of Oxford (and St. John’s College) and MSc in Cognitive Science and BSc in Psychology from the New Bulgarian University. Ivo has a track record of research in cognitive science and behavioural economics, which is published in peer-reviewed academic journals, book chapters and government reports. Dr Sarah Elkin is a consultant in Respiratory Medicine at Imperial College NHS Trust and an Honorary Senior Lecturer at Imperial College London. Her clinical and research interests are in chronic obstructive pulmonary disease (COPD) and delivery of care. She is a member of the NHS England (London) respiratory network. Address for correspondence: Dr Michael J. Taylor, Division of Surgery, Department of Surgery and Cancer, Faculty of Medicine, Imperial College London, St Mary’s Hospital, Room 1092, 10th Floor QEQM Building, South Wharf Road, London W2 1NY, UK. Email: michael.taylor3@imperial.ac.uk

Abstract
Recent advances in communication technologies enable potential provision of remote education for patients using computer-generated environments known as virtual worlds. Previous research has revealed highly variable levels of patient receptiveness to using information technologies for healthcare-related purposes. This preliminary study involved implementing a questionnaire investigating attitudes and access to computer technologies of respiratory outpatients in order to assess potential for use of virtual worlds to facilitate health-related education for this sample. Ninety-four patients with a chronic respiratory condition completed surveys, which were distributed at a Chest Clinic. In accordance with our prediction, younger participants were more likely to be able to use and have access to a computer, and some patients were keen to explore use virtual worlds for healthcare-related purposes: Of those with access to computer facilities, 14.50% expressed a willingness to attend a virtual world focus group. Results indicate that future virtual world health education facilities should be designed to cater to younger patients because this group is most likely to accept and use such facilities. Within the study sample, this is likely to comprise of people diagnosed with asthma. Future work could investigate the potential of creating a virtual world asthma education facility.

Introduction
With the increasing availability of broadband Internet (Bojnec & Fertó, 2012) and advances in computing technologies, growing numbers of people are interacting online, using various communication techniques including voice- and video-conferencing (Jones & Fox, 2009; National...
Some interact using computer-generated environments known as “Virtual worlds” (Bainbridge, 2007). Virtual worlds can be accessed by multiple users, who interact with one another using digital self-representations known as “avatars” (Bainbridge, 2007). This platform supports transmission of visual and auditory information, as well as a virtual environment that can be complex, interactive and three-dimensional, enabling the implementation of novel and innovative education and engagement techniques (Boulos, Maramba & Wheeler, 2006; Taylor et al., 2013a; Taylor, Taylor, Kulendran, Gately & Darzi, 2013b; Warburton, 2009). All that is needed to access a virtual world is a computer connected to broadband Internet (Bainbridge, 2007), so a large number of health service users could access, and benefit from, educational facilities represented in this medium. With guidance from healthcare researchers and clinical staff, developers can create virtual world facilities that provide specialist information or services that are purpose-built for particular patient groups (Boulos et al., 2013).
2006; Boulos, Hetherington & Wheeler, 2007). For example, researchers have created interactive games that are accessible on a virtual “island” within the virtual world of Second Life that aim to teach weight-management techniques to obese people; one of these games is based in a virtual restaurant, and involves the user practising making healthy meal choices from the menu (Johnston et al., 2012).

**Using virtual worlds for healthcare education**

The usefulness of virtual worlds in healthcare-related education has been described and demonstrated (Boulos et al. 2007; Rogers, 2011; Wiecha, Heyden, Sternthal & Merialdi, 2010), but there is considerable further potential for their use and adoption in this field. For example, there is a paucity of research investigating the feasibility of using virtual worlds to support patient education. This preliminary study explored the possibility of virtual worlds being used by a group of patients: we collected questionnaire data to examine attitudes and access to computing equipment by a group of health service users who could benefit from using remote, virtual world-based educational resources.

Virtual worlds can be used to generate realistic representations of real-world locations, which can result in a considerably immersive user experience (Hall, Conboy-Hill & Taylor, 2011; Warburton, 2009). Two key advantages of using virtual worlds for health-related education are that (1) they can be used to create simulations that would be difficult or expensive to construct in real life (Cohen et al., 2013; Kulendran, Taylor, Taylor & Darzi, 2013) and (2) they can be used to connect geographically dispersed individuals (Taylor et al. 2013a). The main advantage of using virtual worlds to communicate electronically, in comparison with alternatives such as Skype™ is that users sharing the 3D environment can get a sense of “togetherness” from being in the “same” (albeit virtual) location (Ma & Agarwal, 2007): communicating in a virtual world can give users a subjective impression that they are sharing physical space with another person, who in fact is communicating from a different place entirely. Studies in healthcare education demonstrating these advantages include one where a virtual world-based simulated operating theatre was used to teach theatre etiquette to medical students, who were more likely to achieve their learning objectives than those who took part in the traditional lecture-based learning (Patel et al., 2012); this is likely to have been due to the superior information retention that can result from learning in a contextually relevant environment (Smith & Vela, 2001).

Virtual worlds can be a useful tool for patient education. A realistic, immersive, virtual representation of a part of the United Kingdom (UK) town of Brighton, complete with one of its hospitals, was constructed so that Brighton residents with learning disability could take a virtual tour of the hospital to make the clinical environment feel more familiar and less daunting when visited for real (Hall et al., 2011). This virtual hospital was effective in representing the environment of the real building, and the virtual tour was an enjoyable experience for the participants, indicating the potential for virtual world facilities to be usefully accessed by a wide range of people, including those with cognitive and communication impairments. Virtual worlds have also been used to successfully deliver lifestyle education (Johnston et al., 2012; Lee, Johnston, Massey & DeVaneaux, 2011), with remote virtual world-based lifestyle education sessions being successful in encouraging overweight participants to diet, exercise and gain confidence in equivalent face-to-face sessions (Johnston et al., 2012). In subsequent interviews, participants reporting to have been inspired by their own avatar’s simulated healthy behaviours such as drinking water more frequently and running on a treadmill (Johnston et al., 2012).

**Using virtual worlds for remote communication in health care**

Focus groups provide an opportunity for patients to exchange experience-based information about health care. These interactions can result in useful learning experiences for the patients,
clinical staff and healthcare researchers (Smith, Scammon & Beck, 1995). These interactions involving groups of patients can enhance the shared learning that occurs, in comparison with interactions with single patients, which is a more typical occurrence in clinical settings (Kitzinger, 1995). Focus groups require a number of patients and a facilitator to be in the same place at the same time; travelling, however, is difficult or impossible for many patients. Online support groups can empower patients (Bartlett & Coulson, 2011) and enable interaction without the need for their members to travel. Virtual worlds are effective in supporting remote communication and collaboration (Kahai, Carroll & Jestice, 2007), so they would be useful for hosting such focus groups. A virtual world focus group session could involve a facilitator and a number of attendees logging in from their respective homes, places of work or wherever might be most convenient. The group members could meet, using their avatars, in a virtual meeting room and discuss (using spoken or written communication) a health-related issue; perhaps one that had been identified by the patient attendees as an important factor affecting their quality of hospital experience. Tools such as virtual wall charts could be used to document or explain meeting events. Information from such meetings could be recorded and fed back to healthcare managers and clinical practitioners to inform practice and policy, with the aim of improving quality of patient care. Focus group discussion outcomes could be used to highlight aspects of healthcare delivery that are of particular importance to the patients (Smith et al., 1995).

A recent study explored the feasibility of using virtual worlds to host group discussion sessions for patients with long-term health conditions to support patient and public engagement (PPE) in health care (Taylor et al., 2013a). Participants reported that virtual worlds are useful in enabling those with mobility and communication difficulties to meet with others, become more engaged in health research and design, and feel less isolated (Taylor et al., 2013a). They also reported that an important disadvantage of virtual world use in this context was that potential beneficiaries do not always have computer and Internet access. Because virtual worlds support high-quality interactions from remote locations (Kahai et al., 2007), patients with mobility and communication difficulties could particularly benefit from using this technology (Taylor et al., 2013a). It is for this reason that this study investigated potential for virtual world use by patients with respiratory problems, whose conditions can cause them to experience such difficulties (Guthrie, Hill & Muers, 2001).

Technology accessibility and acceptance are important factors to take into account when considering virtual world adoption. Attitudes towards, and accessibility to novel technologies by patients are variable and difficult to predict (Or & Karsh, 2009; Qureshi & Kvedar, 2003). Information technology (IT) is viewed by some patients as a tool that empowers them to participate in health-related knowledge sharing and decision-making (Anderson et al., 1995; Brennan & Safran, 2005), and enhances their engagement and involvement opportunities (Stewart, Wilson, Selby & Darbyshire, 2011). A recent systematic review investigating patients’ attitudes towards health-related IT revealed multiple predictors for acceptance including demographic, social and organisational factors (Or & Karsh, 2009). Age and gender were not consistent predictors across studies, although it was demonstrated that prior exposure to IT increased likelihood of acceptance (Or & Karsh, 2009), but for some, prior exposure and knowledge of IT can result in patients being against the idea of use of IT in health care (Rogers & Mead, 2004). Patients perceiving IT to be difficult to use (Fetscherin & Lattemann, 2008), or that its use has a lack of utility and pertinence to their healthcare management (Rogers & Mead, 2004), can negatively impact acceptance.

In summary, there is evidence for virtual worlds being highly useful for remote education and communication, especially for people with communication and mobility problems. There is a
paucity, however, of research investigating attitudes of patients towards possible use of virtual worlds for health-related education.

**Aims of the present study**
The present exploratory study investigated the feasibility of patients diagnosed with respiratory diseases using virtual worlds to attend focus group meetings. An important consideration is that only those with computer and Internet access would be able to use such facilities. This study investigated the prevalence of computer and Internet access and experience in a population of respiratory patients, and whether this group would be interested and willing to take part in an online, virtual world-based patient focus group. Despite a large increase in Internet usage by adults aged over 55 and over 65 in the UK in the last 6 years, there is evidence that in the general population, these age groups are still less likely to use computers and the Internet (National Statistics, U.K. 2013). We hypothesised that the results of our study would reflect this trend, with older participants being less likely to have computer and Internet access. The study aim was to conduct a preliminary investigation on the prevalence of acceptance of use of virtual worlds for focus groups by members of the identified patient sample.

**Methods**

**Questionnaire construction**
This study received ethical approval by the appropriate institutional committee. A questionnaire was constructed (see Appendix S1), which contained written information on virtual worlds. This was followed by items that related to computer and Internet access, and requested respondents’ views on whether they would like to attend an online “virtual” focus group session, a face-to-face focus group to discuss the feasibility and acceptability of online focus groups, or both. The questionnaire also contained items asking about extent of participant experience of popular electronic communication methods Facebook Chat™, Skype™ and the virtual world of Second Life, because this could be used as an indicator of extent of participant experience of web-based communication methods, and thereby of the extent of technical support provision for users in the event of a virtual facility for patients being created. The questionnaire was developed with the help of patients and clinicians in an effort for the questions and information to be clear, accurate, succinct and easy to understand.

**Participants**
The participant eligibility criterion was to have been diagnosed with a respiratory illness. Recruitment took place at a weekly chest clinic, which was based at a hospital in southern England, and was usually attended by approximately 30 people. A member of the research team approached clinic attendees at random and provided the questionnaire after describing the study verbally. The questionnaire was completed by 94 participants (51.8% of the 85 who disclosed gender were female) who were aged 20 to 87 ($M = 63.59, SD = 14.47$ [11 did not disclose age]). Of the 66 participants who disclosed the respiratory condition with which they had been diagnosed, 51 had a single respiratory diagnosis, 14 had two diagnoses and one participant had three diagnoses (see Table 1). Overall, 34.8% had chronic obstructive pulmonary disease (COPD), 18.2% had community-acquired pneumonia (CAP), 51.5% had asthma and 22.7% had a different respiratory condition.

**Procedure**
Completion of the questionnaire usually took less than 10 minutes. Participants were given the choice of reading the questionnaire and information themselves or having this information read to them by a member of the research team. They could also choose whether to write their answers themselves, or for a member of the research team to write answers on their behalf. This meant that no participant was excluded due to not being able to read or complete the questionnaire.
Concerted efforts were made by the researchers during interactions with participants to ensure that they understood the study and questionnaire items, and what participation in the face-to-face and virtual world focus groups would involve. The virtual world was explained in terms that the participant understood; for example, if the participant knew what a 3D computer game looked like, the researcher outlined ways in which virtual worlds are similar and different to computer games familiar to the participant. If the participant had no familiarity with computer games, the concept was explained as a 3D representation of real life on a computer screen, where the user can control a computer-generated character that represents them.

Analytic strategy
Logistic regression tests were used to investigate possible associations between participant age and whether or not they were able to use computers and whether they had one at home. Chi-squared tests were used to investigate relationships between ways in which participants used their computers and whether or not they were interested in taking part in a virtual world focus group.

Results
Computer and Internet access
Just over half of the sample (56.8%, n = 54) reported that they understood how to use a computer (see Table 2 for a summary of computer access and computer use variables). The majority (65.3%, n = 62) reported having a computer at their home, usually (n = 48), with a broadband

| Diagnosis                  | Participant n (%) |
|----------------------------|-------------------|
| COPD only                  | 9 (13.6)          |
| CAP only                   | 6 (9.1)           |
| Asthma only                | 21 (31.8)         |
| COPD and asthma            | 9 (13.6)          |
| COPD and CAP               | 4 (6.1)           |
| CAP and asthma             | 1 (1.5)           |
| COPD, CAP and asthma       | 1 (1.5)           |
| Different respiratory diagnosis | 15 (22.7) |
| Total who disclosed condition | 66 (100)        |

CAP, community-acquired pneumonia; COPD, chronic obstructive pulmonary disease.

Table 2: Summary of computer access and computer use variables

| Computer and Internet access of respondents (percentages relate to all participants) | Participant n (%) |
|-------------------------------------------------------------------------------------|-------------------|
| Understood how to use a computer                                                  | 54 (56.8%)        |
| Have access to a computer at home                                                 | 62 (65.3%)        |
| Have broadband Internet access at home                                            | 48 (51.1%)        |
| Have a relative with access to a computer                                         | 77 (81.9%)        |
| Purposes for using computers reported by respondents (percentages are in relation to participants with access to a computer at home) |               |
| Seeking information                                                               | 19 (30.6%)        |
| Email                                                                              | 15 (24.2%)        |
| Other electronic social interactions                                              | 14 (22.6%)        |
| Shopping                                                                          | 10 (16.1%)        |
| Work                                                                               | 9 (14.5%)         |
| Playing games                                                                     | 4 (6.5%)          |
| Online banking                                                                    | 4 (6.5%)          |
Internet connection. Of those who did not understand how to use a computer, 74% \((n = 30)\) had at least one relative who used computers. Logistic regression revealed younger participants to be significantly more likely to know how to use computers \((\beta = -0.036, p = .037)\), and to have a computer at home \((\beta = -0.063, p = .004)\).

Twenty participants \((21.3\% \text{ of the sample})\) reported to using Skype™ or Facebook Chat™, 16 \((17.0\%)\) reported having a microphone or a headset with a microphone, and six \((6.3\%)\) played modern video games; none of the participants had experience of using the virtual world Second Life.

Computer-using participants were asked what they used their computers for, and were able to cite as many items as they wanted. Nineteen reported using computers for seeking information, 15 for email, 14 for other electronic social interactions (for example, instant messaging or Facebook™), 10 for shopping, 9 for work, 4 for playing games and 4 for online banking.

Interest in taking part in virtual world focus groups

Of the participants with computer access, 14.5\% \((n = 9)\) expressed interest in attending a virtual world focus group. Six of these participants also stated they would like to take part in a face-to-face focus group discussion. One participant expressed interest in taking part in the face-to-face discussion, but not the virtual world group.

Of participants who knew how to use a computer, those who cited using their computer for social communication methods other than email (such as Skype™, Facebook™ or instant messaging) were more likely to report being interested in taking part in the virtual world focus group than those who did not \((\chi^2(1) = 6.00, p = .014)\). No relationship was revealed between whether participants were interested in taking part in the virtual world focus group and whether they used their computers for any of the other reported activities, which included work \((\chi^2(1) = 0.24, p = .624)\), shopping \((\chi^2(1) = 1.57, p = .210)\), banking \((\chi^2(1) = 0.864, p = .353)\) or playing games \((\chi^2(1) = 0.216, p = .642)\).

Fifteen participants reported reasons why they would not be interested in attending focus group discussions. Almost all of these reasons \((n = 14)\) related to them not having enough time to take part. The remaining reason was “Sounds like another way of wasting precious resources that could be used for clinical purposes.” Four participants gave reasons for why they would be interested in attending a virtual world group (see Table 3).

**Discussion**

Only a minority of the sample expressed interest in taking part in a virtual world focus group, and a considerable proportion did not have the necessary system requirements (computer and internet connection) or the computer skills to be able to use virtual world facilities without training and support. Most participants, however, reported to have at least one computer-literate relative who could possibly provide some of this required support.

As predicted, older participants were less likely to have a computer at home and know how to use computers. This finding is in accordance with UK data on Internet access by the general public.
population (National Statistics, U.K., 2013), though it is a useful finding to have attained for the study population because the relationship between age and health technology use and acceptance is inconsistent and hard to predict across groups of patients (Or & Karsh, 2009), and there has been a recent dramatic rise in the number of older adults using computers and the Internet in recent years (National Statistics, U.K., 2013). There is evidence that this trend is likely to continue, both in the UK and in other developed nations (Wagner, Hassanein & Head, 2010). Previous research has found that important reasons for non-acceptance of computing technologies by older patients often relate to their lower levels of computer literacy and familiarity (Mitzner et al., 2014). However, as the population ages and Internet use becomes more widespread, adults aged 55 and over are becoming a faster-growing group of Internet and computer users than younger adults (Wagner et al., 2010): perhaps in a few year’s time, the number of older adults using virtual worlds will be much larger.

Overall, the number of positive responses to the prospect of participating in virtual world focus groups was relatively low: some participants declined for reasons relating to time, others because they were not convinced of the merits of such a facility. Furthermore, many participants did not have access to, or familiarity with, virtual worlds or the technology that is needed to access them. These factors would limit the number of virtual world facility users. Important questions to consider are what the optimum number of users of a virtual world patient group facility would be, and how this number of users could be recruited. Broadening the criteria of users, by creating a facility for hosting meetings for groups of patients with any long-term condition, for example, might increase the number of patient users. However, a less specific healthcare-related facility may not appeal to those interested in learning about particular conditions they are affected by, and it would be difficult to populate such a virtual area with specific and useful health-related information for all attendees if this group was affected by a wide range of conditions. Focus groups targeting specific healthcare contexts can gain in-depth knowledge about how relevant areas of healthcare delivery can be improved (DerkSEN et al., 2012), and this knowledge may be harder to gain from a group where several disease areas are represented.

It would also be useful for future work to investigate how the benefits of using a virtual world for health-related purposes can be made as clear and transparent as possible to potential users, perhaps especially those who are unfamiliar with virtual worlds. In this study, those who reported using social media to communicate were more likely to indicate being interested in participating in a virtual world focus group, and it may be that non-familiarity with online multimedia communication methods makes individuals less keen to use other newer forms of communication such as virtual worlds. Virtual worlds were described verbally and with written information to participants, as we thought this the most appropriate way of conveying the information in a clinic waiting room, because we did not want our data collection to be disruptive or distracting to non-participating patients or to staff. A limitation of this approach, however, was that participants did not get a chance try using a virtual world. Future similar surveys could involve use of tablet computers displaying video demonstrations of virtual worlds, or web-based virtual worlds with which participants could interact. This might be particularly effective in revealing the potential advantages of using this technology.

It can be difficult to predict the receptiveness of patient populations towards new IT platforms for education. Although previous findings suggest that age, gender and computer experience can affect novel IT acceptance, little is known about how these factors may interact with one another (Or & Karsh, 2009). We explored a specific idea for virtual world use by a specific group of patients, but there are myriad ways that virtual worlds could be used, and a wide variety of types of patient groups for whom these could be made available: virtual world focus groups might be a more popular idea among patients with a different type of health condition and different
demographic characteristics. It is also possible that an alternative type of health-related virtual world facility, other than a focus group platform, would be more appealing to patients across condition type. This could be investigated by comparing virtual world acceptability for health-related uses across patients affected by different health conditions. It would be important to consider that different types of diseases can affect different demographics of patients, which may affect study findings. Another consideration with this type of study is that participants’ own perceptions of their health conditions can differ from the perceptions of the health professionals who provide their health care.

Results of the present study indicate the younger participants of the sample to have been more likely to be able to access and use computers, making them more likely to be able to use virtual worlds. Within respiratory patient groups, asthma is more likely to affect younger individuals than other commonly occurring conditions such as CAP or COPD because it tends to occur considerably earlier in life (Mannino & Buist, 2007; Ross Anderson, Gupta, Strachan & Limb, 2007). If an educational virtual world health education facility were to be provided, it would be useful to tailor resources to the needs of patients diagnosed with a particular condition to enable effective administration of information and techniques relevant to that specific group. For example, a virtual depiction of a person using an asthma inhaler correctly could be used to teach inhaler technique. A virtual world facility such as this would also allow visitors to interact with one another, enabling users to (1) meet similar people and (2) find out more about their own condition: two of the advantages of virtual world health education communication platforms reported by patients in this study.

In the event of providing a virtual world facility, it is crucial that any communications conducted with the target user group should be done using methods and language that are familiar and comprehensible to recipients. When defining “virtual worlds” to an audience who might be new to the concept, it is paramount to ensure that those who could benefit are adequately well informed to be motivated to try using the technology and are not misinformed or misled by use of esoteric terminology. Correspondence with users of a virtual world facility should be conducted in ways appropriate to the patient group to whom it is most likely to be useful; knowing the age and computer skills of the target population would help to inform the content and wording of any promotional messages and materials to recruit members for a group, and to keep these members updated with any developments. It should also be considered that the patients who could benefit to the greatest extent might be those with communication or mobility difficulties, who might be isolated and feel disempowered. Great care should be taken to ensure sensitivity of this in all communications with the group, including in dissemination and promotion of facilities, user technical support and any focus groups that take place.

Conclusions
There is potential for use of new virtual world-based education techniques to facilitate remote information sharing and education for patients. As far as we are aware, the present study is the first to examine potential of virtual worlds for hosting focus groups for respiratory patients. A small sample of these patients expressed interest in participating in a virtual world patient focus group, with lack of time being the most frequently cited reason for non-participation. Younger patients were more likely to have access to, and be able to use computers, so future research investigating potential use of virtual worlds to provide education to respiratory patients could aim to recruit younger patients to maximise participation. This research could investigate technical and logistical feasibility of virtual worlds providing learning facilities for patients with asthma and could examine the relative effectiveness of such online education techniques in comparison with equivalent face-to-face educational methods.
Statements on open data, ethics and conflict of interest

a. The quantitative data collected for this study can be accessed, by request, by contacting Michael J. Taylor.

b. This project was granted ethical approval by the National Health Service (NHS) National Research Ethics Service (NRES). Participant data were anonymised using numerical codes, and no details of participants are published that can make them personally identifiable.

c. The authors declare no conflict of interest and confirm that all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story. This paper presents independent research commissioned by the National Institute for Health Research (NIHR) under the Collaborations for Leadership in Applied Health Research and Care (CLAHRC) programme for North West London. The views expressed in this publication are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

References

Anderson, R. M., Funnell, M. M., Butler, P. M., Arnold, M. S., Fitzgerald, J. T. & Feste, C. C. (1995). Patient empowerment: results of a randomized controlled trial. Diabetes Care, 18, 7, 943–949. doi: 10.2337/diacare.18.7.943.

Bainbridge, W. S. (2007). The scientific research potential of virtual worlds. Science, 317, 5837, 472–476. doi: 10.1126/science.1146930.

Bartlett, Y. K. & Coulson, N. S. (2011). An investigation into the empowerment effects of using online support groups and how this affects health professional/patient communication. Patient Education and Counseling, 83, 1, 113–119.

Bojnec, Š. & Ferto˝, I. (2012). Broadband availability and economic growth. Industrial Management & Data Systems, 112, 9, 1292–1306. doi: 10.1108/02635571211278938.

Boulos, M. N., Maramba, I. & Wheeler, S. (2006). Wikis, blogs and podcasts: a new generation of web-based tools for virtual collaborative clinical practice and education. BMC Medical Education, 6, 41.

Boulos, M. N., Hetherington, L. & Wheeler, S. (2007). Second Life: an overview of the potential of 3-D virtual worlds in medical and health education. Health Information & Libraries Journal, 24, 4, 233–245. doi: 10.1111/j.1471-1842.2007.00733.x.

Brennan, P. & Safran, C. (2005). Empowered consumers. In D. Lewis, G. Eysenbach, R. Kukafka, Z. Stavri & H. B. Jimison (Eds.), Consumer Health Informatics (pp. 8–21). New York, NY: Springer.

Cohen, D., Sevdalis, N., Patel, V., Taylor, M., Lee, H., Vokes, M. et al (2013). Tactical and operational response to major incidents: feasibility and reliability of skills assessment using novel virtual environments. Resuscitation, 84, 7, 992–998.

Derksen, R., Brink-Melis, W., Westerman, M., ten Dam, J., Seidell, J. & Visscher, T. (2012). A local consensus process making use of focus groups to enhance the implementation of a national integrated health care standard on obesity care. Family Practice. 29, Suppl. 1, i177–i184.

Fetscherin, M. & Lattemann, C. (2008). User acceptance of virtual worlds. Journal of Electronic Commerce Research, 9, 3, 231–242.

Guthrie, S. J., Hill, K. M. & Muers, M. E. (2001). Living with severe COPD. A qualitative exploration of the experience of patients in Leeds. Respiratory Medicine, 95, 3, 196–204.

Hall, V., Conboy-Hill, S. & Taylor, D. (2011). Using virtual reality to provide health care information to people with intellectual disabilities: acceptability, usability, and potential utility. Journal of Medical Internet Research, 13, 4, e91. doi: 10.2196/jmir.1917.

Johnston, J. D., Massey, A. P. & DeVaneaux, C. (2012). Innovation in weight loss intervention programs: an examination of a 3D virtual world approach. 2012 45th Hawaii International Conference on System Sciences, 2890–2899.

Jones, S. & Fox, S. (2009). Generations online in 2009. Washington, DC: Pew Internet & American Life Project. Kahai, S. S., Carroll, E. & Jestice, R. (2007). Team collaboration in virtual worlds. SIGMIS Database, 38, 4, 61–68. doi: 10.1145/1314234.1314246.

Kitzinger, J. (1995). Qualitative research. Introducing focus groups. BMJ (Clinical Research Ed.), 311, 7000, 299–302.

Kulendran, M., Taylor, M., Taylor, D. & Darzi, A. (2013). 3D Simulation of a hospital environment and ward round to augment a summer school program for pre-medical students. Studies in Health Technology and Informatics, 196, 209–214.
Lee, V. S., Johnston, J. D., Massey, A. P. & DeVaneaux, C. (2011). Comparison of a face-to-face verses virtual world weight loss program: 2595: board #203 June 3 8:00 am–9:30 am. Medicine & Science in Sports & Exercise, 43, 5, 716. doi: 10.1249/01.MSS.0000401987.11558.c6.

Ma, M. & Agarwal, R. (2007). Through a glass darkly: information technology design, identity verification, and knowledge contribution in online communities. Information Systems Research, 18, 1, 42. doi: 10.1287/isre.1070.0113.

Mannino, D. M. & Buist, A. S. (2007). Global burden of COPD: risk factors, prevalence, and future trends. The Lancet, 370, 9589, 765–773.

Mitzner, T. L., Rogers, W. A., Fisk, A. D., Boot, W. R., Charness, N., Czaja, S. J. et al (2014). Predicting older adults’ perceptions about a computer system designed for seniors. Universal Access in the Information Society, doi: 10.1007/s10209-014-0383-y.

National Statistics, U.K. (2013). Internet access—households and individuals. Retrieved September 13, 2014, from http://www.ons.gov.uk/ons/dcp171778_322713.pdf

Or, C. K. & Karsh, B. T. (2009). A systematic review of patient acceptance of consumer health information technology. Journal of the American Medical Informatics Association, 16, 4, 550–560. doi: 10.1197/jamia.M2888.

Patel, V., Aggarwal, R., Osinibi, E., Taylor, D., Arora, S. & Darzi, A. (2012). Operating room introduction for the novice. The American Journal of Surgery, 203, 2, 266–275.

Qureshi, A. A. & Kvedar, J. C. (2003). Patient knowledge and attitude toward information technology and teledermatology: some tentative findings. Telemedicine Journal and E-health: the Official Journal of the American Telemedicine Association, 9, 3, 259–264.

Rogers, A. & Mead, N. (2004). More than technology and access: primary care patients’ views on the use and non-use of health information in the Internet age. Health & Social Care in the Community, 12, 2, 102–110. doi: 10.1111/j.0966-0410.2004.00473.x.

Rogers, L. (2011). Developing simulations in multi-user virtual environments to enhance healthcare education. British Journal of Educational Technology, 42, 4, 608–615.

Ross Anderson, H., Gupta, R., Strachan, D. P. & Limb, E. S. (2007). 50 years of asthma: UK trends from 1955 to 2004. Thorax, 62, 1, 85–90. doi: 10.1136/thx.2006.066407.

Smith, J. A., Scammon, D. L. & Beck, S. L. (1995). Using patient focus groups for new patient services. The Joint Commission Journal on Quality Improvement, 21, 1, 22–31.

Smith, S. M. & Vela, E. (2001). Environmental context-dependent memory: a review and meta-analysis. Psychonomic Bulletin & Review, 8, 2, 203–220.

Stewart, D., Wilson, R., Selby, P. & Darbyshire, J. (2011). Patient and public involvement. Annals of Oncology, 22, Suppl. 7, vii54–vii56. doi: 10.1093/annonc/mdr427.

Taylor, M. J., Kaur, M., Sharma, U., Taylor, D., Reed, J. E. & Darzi, A. (2013a). Using virtual worlds for patient and public engagement. International Journal of Technology, Knowledge and Society, 9, 2, 31–48.

Taylor, M. J., Taylor, D., Kulendran, M., Gately, P. & Darzi, A. (2013b). Virtual worlds as a tool to facilitate weight management for young people. Journal For Virtual Worlds Research, 6, 1, doi: 10.4101/jvwr.v6i1.7026.

Wagner, N., Hassanein, K. & Head, M. (2010). Computer use by older adults: a multi-disciplinary review. Computers in Human Behavior, 26, 5, 870–882.

Warburton, S. (2009). Second life in higher education: assessing the potential for and the barriers to deploying virtual worlds in learning and teaching. British Journal of Educational Technology, 40, 3, 414–426. doi: 10.1111/j.1467-8535.2009.00952.x.

Wiecha, J., Heyden, R., Sternthal, E. & Merialdi, M. (2010). Learning in a virtual world: experience with using second life for medical education. Journal of Medical Internet Research, 12, 1, e1.

Supporting information
Additional Supporting Information may be found in the online version of this article at the publisher’s web-site:
Appendix S1 The questionnaire.