

## Refereed paper

# Leveraging time and learning style, iPod vs. realtime attendance at a series of medicine residents conferences: a randomised controlled trial

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## ABSTRACT

**Objective** To determine whether participation in educational conferences utilising iPod technology enhances both medical knowledge and accessibility to educational content among medical residents in training.

**Design/measurements** In May 2007, the authors led a randomised controlled study involving 30 internal medicine residents who volunteered either to attend five midday educational conferences or to use an iPod audio/video recording of the same conferences, each followed by a five-question competency quiz. Primary outcomes included quantitative assessment of knowledge acquisition and qualitative assessment of resident perception of ease of use. Secondary outcomes included resident perception of self-directed learning.

**Results** At baseline, residents reported attendance at 50% of educational conferences. Of iPod participants, 46.7% previously used an iPod. During the study, 46–60% of conference attendees were paged out of each conference, of whom between 6 and

33% missed more than half of the conference. The quiz completion rate was 93%. Key findings were: 1) similar quiz scores were achieved by conference attendees, mean 60.7% (95% CI; 53.0–68.3%), compared to the iPod user group, mean 67.6% (95% CI; 61%–74.1%), and

2) the majority (10/15, 66.6%) of conference attendees stated they would probably benefit from the option to refer back to conferences for content review and educational purposes.

**Conclusions** Residency training programmes can optimise time management strategies with the integration of innovative learning resources into educational curricula. This study suggests that iPod capture of conferences is a reasonable resource to help meet the educational goals of residents and residency programs.

**Keywords:** electronic curricula, iPod, resident education

## Introduction

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In 2003, concerned that resident sleep deprivation has detrimental effects on patient safety and resident education and wellbeing, the Accreditation Council for Graduate Medical Education (ACGME) implemented duty-hour restrictions for all residency programs in the United States.<sup>1</sup> Since the implementation of these regulations, graduate medical education programmes have devised innovative methods to meet residents' educational needs, such as rearranging call schedules, creating new hospital coverage systems, and employing hospitalists. Few programmes have looked for informatics solutions.

## Background

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The potential benefits of the duty-hour regulations include reductions in medical errors and increased opportunities for self-directed learning.<sup>2,3</sup> However, duty-hour reform has failed to demonstrate improvements in patient mortality.<sup>4</sup> Recent increases in medical errors in hospitals may result from duty-hour reform as the number of patient handovers between ward teams has dramatically increased since 2003.<sup>5-7</sup> Complying with the ACGME duty-hour reform, residents now find attending educational conferences more difficult and perceive the new system as negatively affecting their medical education.<sup>5-10</sup>

McDonald *et al*<sup>11</sup> discovered that residents who attended educational conferences on average twice per week experienced a 3.9% increase in their Internal Medicine In-Training Examination (IM-ITE) score. Graduate medical education programmes value the IM-ITE score as a predictor for a successful outcome on the American Board of Internal Medicine Certification Examination (ABIM-CE).<sup>11</sup> Reading an electronic knowledge resource for 20 minutes per day was shown to provide an additional 3.7% increase in residents' IM-ITE scores.<sup>11</sup>

Residents' access to electronic medical information for self-directed learning has increased exponentially. Technological enhancements in high-speed internet access and high-capacity portable media players have led to the development of the 'podcast,' a new information medium.<sup>12</sup> Podcast, a portmanteau of the words 'iPod' and 'broadcast', is an electronic media file (audio or video) which is distributed over the internet and downloaded for playback on either a mobile device or personal computer. We will use the term podcast generically to refer to our video files which were viewable within iTunes or via an iPod.

In 2004, Duke University in Durham, North Carolina pioneered podcasting in the undergraduate curriculum, citing benefits of convenience, effectiveness, ease-of-use, greater student engagement and enhanced support for individual learning preferences.<sup>13</sup> Recent increases in medical journal podcast publications from, for example, *The New England Journal of Medicine* and the *Journal of the American Medical Association*, suggest that medical professionals are beginning to incorporate podcasts into their self-directed learning. With improvements in podcast technology and usability, medical educators are now incorporating podcasting into medical education. However, there are still barriers to podcast utilisation, including challenges with integrating multiple systems for content storage and sharing, distribution, limited training resources, and lack of familiarity with iPod capabilities.

## Research question

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We sought to assess whether medical resident participation in educational conferences using mobile iPod technology enhances both medical knowledge and accessibility to educational conferences when compared to residents only participating in person at live educational conferences. The secondary outcomes assessed were the perception of self-directed learning among residents utilising iPod technology, residents' perception of the value of iPod technology for education and the usability of iTunes technology.

## Methods

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Participants were the first 30 residents from the Department of Medicine at Duke University to respond to an announcement of the study which required residents to attend five prescheduled midday educational conferences in May 2007. All residents were informed of the study at the same time and there was no discrimination on the basis of year of training or familiarity with computer technology. Our budget limited the number of participants to 30, as each participant received a video iPod device.

The conferences were part of a midday lecture series in May 2007 on clinical topics for graduate medical education. The speakers were Duke Faculty members presenting specialty topics relevant to patient care. Lectures covered adolescent medicine (two lectures), disseminated intravascular coagulation, tropical emergencies, and arterial blood gas values. Presenters spoke into a standard microphone and projected

MS-Powerpoint™ slides onto a large screen for audience viewing. A computer used Camtasia™ software to synchronise speaker audio with the slide projection to create the video files. Editing the files and uploading them to Duke iTunes, a site within the Duke intranet, required a secure logon ID and password.

The local Institutional Review Board (IRB) permitted waiver of consent on the condition that a neutral third party would protect any identifiers from disclosure. Our neutral third party signed an agreement to hold participant identities confidential and to assist the investigators with the study randomisation and process. The study was thus considered to pose minimal risk to the subjects.

Our protocol called for two study arms, each with 15 participants, each participant having a unique number between 1 and 30 created using a random sequence generator found at [www.random.org/sform.html](http://www.random.org/sform.html). Participants in the control group, 'conference attendees,' were instructed to attend a specific series of five one-hour midday conferences. These attendees were allowed to leave the conference for personal or patient care issues. At the study conclusion, each received a 30GB video iPod. Participants in the intervention group, 'iPod users,' received the same 30GB video iPod with instructions to be absent from the same five conferences. The iPod users received directions about downloading the five conferences from the Duke iTunes website and transferring the conference recordings to an iPod.

Following each of the five conferences, participants received by email a hyperlink to an online, conference-specific survey. Survey completion was anonymous as participants registered with confidential, unique study identification numbers. To mitigate recall bias, surveys were to be completed within seven days of the live conference. All participants were required to respond to the password-protected surveys administered online via 'SurveyMonkey' ([www.surveymonkey.com](http://www.surveymonkey.com)). The surveys consisted of two parts: first, an ABIM-CE formatted quiz, with five presenter-developed content questions targeting the educational objectives for each conference, and second, a list of three to five subjective questions assessing each group's conference experience. The research team developed subjective questions using standard types of questions about usability. Satisfaction measures included missed conference frequency, reasons for missing conferences, identification of benefits of live conference attendance, and identification of the need to review educational conference content in the future.

Primary outcomes addressed the quantitative assessment of knowledge acquisition. Participants were required to answer multiple-choice questions similar to those used in professional board exams such as the ABIM-CE and IM-ITE, and total scores reflected the number of correct responses.

Qualitative assessment gauged the iPod users' perception of ease of use. Responses included free text as well as ordinal variables, e.g. 'surprisingly easy' versus 'have to plan ahead a lot' or 'I don't listen to the entire lecture at once'. Users responded to questions about the time requirements for managing the technology, and the time and location typically used for listening. They were also asked to report what new information they acquired and to suggest areas for improvement.

Secondary outcomes included the participants' perception of improved self-directed learning, the value of podcast technology for education, and usability ratings for the Duke iTunes website, using ordinal variables from 'unsatisfactory' to 'totally the way to go for education'. Users were also asked a question about the overall experience, with the following answer choices: 'never an easy moment for this, fair, has its limitations, a real solution for my lifestyle, really enhanced my learning experience and worked well with my activities, or totally revolutionized learning for me and I can see the future potential'.

Statistical analysis for the quiz results was performed using SAS Enterprise Guide 4.1. The Wilcoxon rank sum test was used to compare mean quiz scores between groups. Sample size calculations were completed with a means comparison test.

## Results

Table 1 provides information about the baseline characteristics of the participants. Of the 30 participants starting the study, one iPod user was lost to follow-up for personal reasons. Three conference attendee surveys and one iPod user survey were not completed. Baseline assessment demonstrated that while the majority of study participants attend a midday conference in person at least 50% of the time, a minority reported attending 60% or more conferences as required under the ACGME guidelines (Table 1).<sup>14</sup> Most respondents found it difficult to attend conferences on post-call days, when residents are generally required to leave by 1pm in order to avoid working more than 30 consecutive hours (Table 1). Baseline familiarity with iPod technology was low, with fewer than half reporting having previously used or owned an iPod, with previous use being primarily restricted to music (Table 1). One participant in each study group (6.6%) reported using an iPod to access medical resources.

Forty-seven to 60 percent of conference attendees were paged out of a conference at least once for each of the five sessions. Other reasons given for missing conference time are listed in Table 2.

Between six and 53 percent of conference attendees believed that there were no secondary gains from

**Table 1** Baseline participant characteristics at start of study

Category	Attendees <i>n</i> (%)	iPod Users <i>n</i> (%)
Self-reported conference attendance		
Seldom	1 (6.0)	3 (20.0)
At least 50%	12 (80.0)	11 (73.3)
60% or more	2 (13.3)	1 (6.0)
Number reporting 'difficult' or 'difficult post-call' to attend conferences	12 (80.0)	13 (86.6)
Number reporting previous use of an iPod	9 (60.0)	7 (46.7)
Of previous iPod users, listening limited to music media	9 (60.0)	5 (33.3)
Number of iPod users reporting use of podcasted medical resources	1 (6.0)	1 (6.0)
Responses to question about experience with an online medical school curriculum		
None	2 (13.3)	2 (13.3)
Up to 25% online	8 (53.3)	9 (60.0)
25% or more online	5 (33.3)	4 (26.6)
Reasons given for not owning an iPod		
Cost	4 (26.6)	5 (33.3)
Lack of interest	2 (13.3)	1 (6.0)

**Table 2** Noon conference attendees: reasons for missing or leaving the conference

Category	<i>n</i> (%)
Paged out of conference	7–9 per session (46–60)
Missed most of the conference due to answering patient care-related pages	1–5 per session (6–33)
Clinic conflict	5 (33.3)
VA conference	1 (6.0)
Rounding with attending	1 (6.0)
Day off	1 (6.0)
Post-call duty hours	1 (6.0)
Other	2 (13.3)

attending the live conference versus electronic participation (Table 3). When noted, perceived secondary gains included social time with colleagues, experiencing the physical presence of the speakers, and the opportunity to interact with the speaker. One participant described conference attendance as providing

'the intangible element that cannot be reproduced electronically'. However, the majority of conference attendees (10 out of 15 or 66.6%) stated they would definitely or very likely benefit from having the option to electronically refer back to attended conferences for content review and educational purposes (Table 3).

**Table 3** Summary of opinions about having access to iPod format

	Level of agreement	<i>n</i> (%)
Would want to access podcast of lectures if available in the future*	Possibly	5 (33.3)
	Very likely	6 (40.0)
	Definitely	4 (26.6)
	Not likely	1 (6.0)
Number of respondents who felt they did not gain anything additional by viewing the lecture in person	1st lecture	4 (26.6)
	2nd lecture	8 (53.3)
	3rd lecture	8 (53.3)
	4th lecture	1 (6.0)

\* of the total responses

**Table 4** Summary of technical details of using the iPod

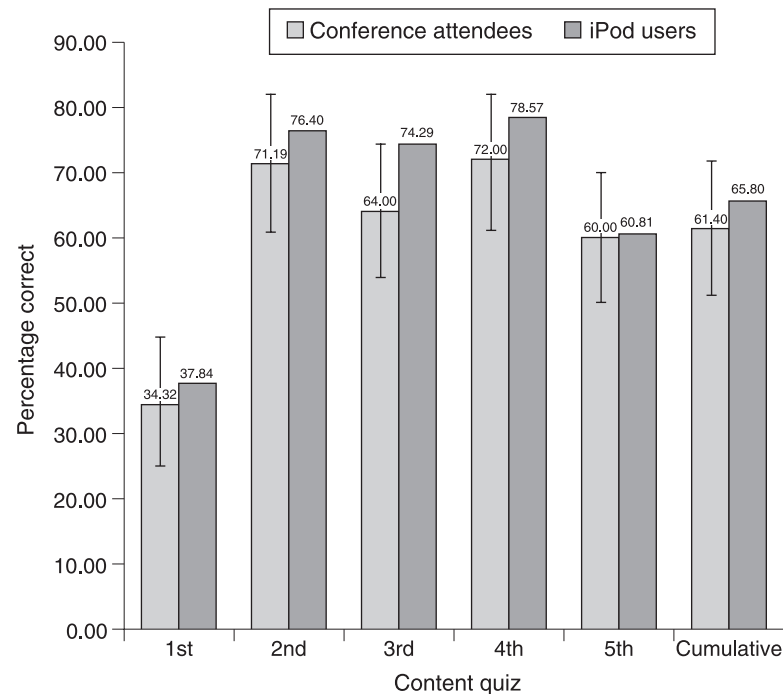
Time questions	Actual time	<i>n</i> (%)
Time to navigate to the file archive	<3 minutes	11 (73.3)
	3–5 minutes	3 (20.0)
	5–10 minutes	1 (6.0)
Time to download the file	≤ 5 minutes	11 (73.3)
	10 minutes	4 (26.6)
Time of day when listening	8 am–5 pm	4 (26.6)
	5 pm–12 midnight	10 (66.6)
	12 midnight–8am	1 (6.0)

Usability ratings of iPod technology among the iPod users are reported in Table 4. Seventy-three percent of the iPod users reported navigating to the iTunes website in less than three minutes and only one (6.0%) iPod user reported a navigation time of between 5 and 10 minutes. Downloading files took five minutes or less for 11 (73%) of the iPod users. The majority, ten (67%) of the iPod users, listened in the evening or night-time hours (5pm–8am). Some iPod users commented that they used weekend afternoons

for listening to the conferences, especially while resting or relaxing at home. One user reported ‘multi-tasking’ – viewing a conference while washing laundry. iPod users mentioned the benefits of portability, convenience, and viewing conferences without interruption. Recorded conference content was uploaded to the Duke iTunes website successfully 100% of the time.

Several iPod users addressed barriers to iPod utilisation for viewing medical conferences. Downloading material was a barrier for those without home internet access, and weather-related internet service interruption was reported by one iPod user. Small screen size prevented the full appreciation of conference tables and graphs for some iPod participants; they therefore they used a desktop or laptop computer to view these conferences instead. Some noted that our podcast format did not allow users to skip between conference slides, and there were some difficulties with the iPod mechanism for fast-forwarding and rewinding. One conference speaker using a Macintosh™ computer was initially unsuccessful in uploading conference content to the Camstasia™ recording program as the software program was not Macintosh™ compatible. There were intermittent times when the Duke iTunes website was down, but they did not interfere with the study.

Ninety-three percent of study participants completed each quiz immediately following the respective conferences. Quiz results demonstrated a high degree of result variance between conferences (Figure 1). The mean percent of correct answers for conference attendees was 60.7% (95% CI; 53.0–68.3%) and the mean percent correct for the iPod users was 67.6% (95% CI; 61%–74.1%). Comparison by student’s t-test revealed no significant differences between groups ( $p=0.15$ ).



**Figure 1** Comparison of lecture quiz results for conference attendees and iPod users

## Discussion

Previous reports about podcast technology focused on subpopulations of undergraduates, nurses or surgical subspecialties and failed to address measures of educational outcomes.<sup>12,15,16</sup> Most studies retrospectively assessed participants' perceptions of change or speculated on the potential benefits of utilising podcasts for educational purposes. We believe this is the first report assessing the implementation of podcast technology in a residency training program curriculum.

Consistent with previous studies, our data suggest that resident work-hour reforms have negative consequences on resident medical education. Despite improvements in sleep deprivation and overall wellbeing, residents now report less uninterrupted time to attend educational conferences. Resident noncompliance with the ACGME policy for minimum attendance at 60% of conferences at our institution was an unanticipated finding and highlights the need for residents to have improved access to conference content. With the constant pressure to attend to clinical duties, it is understandable that 93% of the live conference participants stated they would access electronic conferences if available at their convenience. In addition, the ability to refer to previously attended conferences would reinforce the salient educational points of each conference.

Improvements in IM-ITE performance and the ACGME 60% educational conference attendance policy should motivate residency programs to implement strategies that maximise resident conference

attendance.<sup>11,17,18</sup> The absenteeism for conference attendance alone is a compelling reason to create alternatives to live attendance. Podcasted conferences afford residents the ability to participate in conferences uninterrupted (or at least to pause at their convenience), at times and places more suitable for their schedules. Podcasted conferences are a reasonable adjunct medium for increasing residents' conference participation.

In agreement with the Duke University assessment of podcast integration into undergraduate curricula, our report highlights the potential podcasting has for the self-directed education of residents. While rates of previous iPod utilisation among study subjects were surprisingly low, the residents were very accepting of podcasted material as an additional medical knowledge resource because of the ease-of-use, portability, improved access, and learning style compatibility. Additional medical education resources accessible with podcast technology abound. Graduate Medical Education in the Department of Medicine at Duke University has reformatted its 2007 and 2008 ABIM-CE review course and now delivers an archive of medicine grand rounds and daily educational conferences with podcast accessibility. In addition, podcast subscribers have access to numerous medical journals, journal clubs, Continuing Medical Education (CME) conferences and other medical conferences accessible through free podcast media. Residency training programs implementing podcasts and iPod media into educational curricula will improve resident access to medical education resources and potentially increase resident participation in self-directed education.

There were some limitations associated with iPod use. Conference attendee perception of secondary gains from live attendance varied across conferences and was potentially confounded by the presenter's public speaking abilities. Many iPod participants favoured being present to experience speaker nuances such as verbal and postural cuing. Residents noted a potential drawback to podcasted conference participation as a missed opportunity to interact with and question the lecturer in person. Additionally, the iPod screen size and resolution were often sub-optimal, precluding the viewer's full appreciation of conference tables, charts and videos. Cost was seen as the primary initial barrier to using iPod mobile technology; however, access to content through Duke iTunes is free.

Self-proclaimed resident learning style preferences for electronic medical knowledge acquisition have been previously reported.<sup>19,20</sup> Our study supports these findings and expands upon them as the first study to compare knowledge acquisition by conference attendees to that of participants in podcasted conferences viewed on an iPod. Post-conference quiz scores suggest the non-inferiority of podcast participation to live conference attendance in the acquisition of medical knowledge. Although underpowered and statistically non-significant, our results suggest that podcasts are an equitable adjunct to participation in live conferences. Future studies with more statistical power and improved testing measures, including the IM-ITE, are necessary to confirm the non-inferiority of podcasts to conference attendance for the acquisition of knowledge.

We acknowledge several potential limitations to our study. It is possible that our sample does not accurately represent the resident population. Since study participants were rewarded with a 30GB Apple iPod, we assume that residents who did not previously own an iPod had more incentive to participate in the study than residents who previously did. Therefore, we cannot exclude sampling bias as a possible explanation for the reported low iPod utilisation rates.

Resident perceptions and opinions were assessed following participation in only five conferences. Participation in additional conferences would subject residents to more presenters and perhaps allow better appreciation of their own conference participation preferences.

## Conclusion

To ensure that duty-hour reform does not limit the educational experience of residents, residency training programs must reassess their current curricula. Optimisation of time management strategies with the integration of innovative learning resources into graduate

medical curricula is imperative. Such measures will maximise resident educational conference attendance and increase their electronic medical knowledge resources. This study suggests that podcasted conferences are a reasonable resource to help meet the educational goals of residents and residency programs.

## ACKNOWLEDGEMENTS

The authors wish to thank Dr Barton F Haynes for support via the Haynes Education Fund in the Department of Medicine at Duke University Medical Center. Dr Haynes had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript. This paper was presented in part as a poster to the North Carolina regional meeting of the American College of Physicians in 2008.

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#### CONFLICTS OF INTEREST

None.

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*Accepted April 2009*