

# iPod™ technology for teaching patients about anticoagulation: a pilot study of mobile computer-assisted patient education

Nancy R. Denizard-Thompson<sup>1</sup>, Sonal Singh<sup>2</sup>, Sheila R. Stevens<sup>3</sup>, David P. Miller<sup>4</sup> and James L. Wofford<sup>4</sup>

<sup>1</sup>Assistant Professor, Department of Internal Medicine, Wake Forest University School of Medicine, Winston-Salem, NC, USA

<sup>2</sup>Assistant Professor of Medicine, Department of International Health, Johns Hopkins University School of Medicine, Baltimore, MD, USA

<sup>3</sup>Clinic Nurse Manager, Department of Internal Medicine, Wake Forest University School of Medicine, Winston-Salem, NC, USA

<sup>4</sup>Associate Professor, Department of Internal Medicine, Wake Forest University School of Medicine, Winston-Salem, NC, USA

**Aim:** To determine whether an educational strategy using a handheld, multimedia computer (iPod™) is practical and sustainable for routine office-based patient educational tasks. **Background:** With the limited amount of time allotted to the office encounter and the growing number of patient educational tasks, new strategies are needed to improve the efficiency of patient education. Education of patients anticoagulated with warfarin is considered critical to preventing complications. Despite the dangers associated with the use of warfarin, educational practices are variable and often haphazard. **Methods:** During a four-month period, we examined the implementation of a three-part series of iPod™-based patient educational modules delivered to anticoagulated patients at the time of routine INR (International Normalized Ratio) blood tests for outpatients on the anticoagulation registry at an urban community health center. **Findings:** A total of 141 computer module presentations were delivered to 91 patients during the four-month period. In all, 44 patients on the registry had no INR checkups, and thus no opportunity to view the modules, and 32 patients had at least three INR checkups but no modules were documented. Of the 130 patients with at least one INR performed during the study period, 22 (16.9%) patients completed all three modules, 91 (70.0%) patients received at least one module, and nine (7.6%) patients refused to view at least one module. Neither of the two handheld computers was lost or stolen, and no physician time was used in this routine educational activity. Patients reported that the audio and visual quality was very good, (9.0/10); the educational experience of the patient was helpful (7.4/10) compared with the patient's previous warfarin education (6.3/10), and the computer strategy extended the INR visit duration by 1–5 min at most. **Conclusions:** The computer-assisted patient educational strategy was well received by patients, and uptake of the intervention by the clinic was successful and durable. The iPod™ strategy standardized the educational message, improved clinic efficiency, and helped this busy clinic meet its educational goals for patient education.

---

Correspondence to: Dr James L. Wofford, MD, MS, Department of Internal Medicine, Wake Forest University School of Medicine, Winston-Salem, NC 27157, USA. Email: jwofford@wfubmc.edu

© Cambridge University Press 2011

**Key words:** attitude to computers; computer-assisted instruction/standards; health knowledge, attitudes, practice; patient care planning; patient education; warfarin/administration and dosage

Received 4 November 2010; accepted 3 July 2011; first published online 22 August 2011

## Introduction/rationale

Providing effective and efficient patient education is a challenge for office-based physicians. The amount of time allotted to the office encounter is diminishing, and the number of educational tasks assigned to the office physician is growing (Yarnall *et al.*, 2003). As a result, clinicians are often resigned to hurriedly offering a brochure, delegating the educational task to other busy clinic personnel, or simply leaving the educational task undone. It is not surprising that patient education in the office setting is characterized as hurried, haphazard, uncoordinated, and untargeted (Committee on Quality Health Care in America, 2001; Østbye *et al.*, 2005; Edwards *et al.*, 2009).

For over a decade, it has been recognized that the multimedia computer can serve as a physician extender for patient's educational activities by offering better consistency and quality control of the educational message, and at the same time overcoming literacy and language barriers (Krishna *et al.*, 1997; Wofford *et al.*, 2005). Smaller handheld multimedia computers, such as the iPod™ or cellular phone, offer a more portable delivery system for automating and systematizing patient's educational efforts than is possible with a desktop or laptop computer. Handheld computers offer clinicians the ability to move from one examination room to another, potentially enhancing clinical productivity and patient flow.

Warfarin is arguably one of the most dangerous outpatient medications (Gurwitz *et al.*, 2003; Budnitz *et al.*, 2007). Education of patients using warfarin for anticoagulation is widely considered critical to preventing complications of the medication or underlying condition (Tang *et al.*, 2003; Davis *et al.*, 2005). Despite the dangers associated with the use of warfarin, educational practices are variable and often haphazard (Wofford *et al.*, 2008). In order to standardize and improve patient's education for patients anticoagulated with warfarin in our clinic population, we created and implemented a series of educational modules for use with the handheld, multimedia computer. With the overall goal of

demonstrating the feasibility of such a system in a busy clinic setting, we specifically sought to characterize whether clinic staff and patients were able to use the handheld computers, complete the educational program, and gain educational benefit.

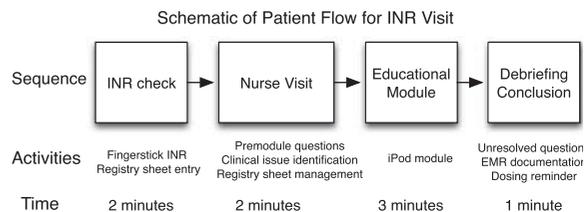
## Implementation/methods

### Setting

Located in Winston-Salem, North Carolina, the Downtown Health Plaza, has provided primary care services to the community for over 25 years. This urban community health center clinic, an outpatient department of North Carolina Baptist Hospital, is staffed by over 50 physicians and mid-level practitioners from the Wake Forest University Baptist Medical Center. The Adult Medicine Clinic (DHPAMC) typically logs more than 20 000 clinic visits each year and serves a large number of medicaid and uninsured patients. The DHPAMC clinic is staffed by five nurses and five certified nursing assistants.

### Anticoagulation registry

Despite the availability of a comprehensive electronic medical record, a paper-based anticoagulation registry has been used in the clinic for over three years. As is routine for any patient on warfarin, an INR (International Normalized Ratio) blood test is monitored on a regular basis in order to monitor the level of anticoagulation (Figure 1). An anticoagulation registry sheet accompanies the patient throughout each INR clinic visit. At the beginning



**Figure 1** Schematic of patient flow for INR (International Normalized Ratio) visit.

Primary Health Care Research & Development 2012; 13: 42–47

of this patient educational project, approximately 150 patients were active members of the registry. We included all patients in the educational intervention, regardless of the duration of warfarin use. Patients may need refresher education, particularly in educational domains for which guidelines may have changed, and studies have shown that long-term warfarin patients can benefit from educational maneuvers (Fang *et al.*, 2006; Zeolla *et al.*, 2006).

Data were collected for four months from 9 August to 9 January 2009, a time period that would allow stable anticoagulated patients three monthly INR checkups and one additional INR visit for the final survey.

### **Content development**

We developed a set of three, sequential educational modules (1 – INR monitoring and management; 2 – nutrition advice for patients on warfarin, and 3 – rationale for anticoagulation). The module content was based on a previous systematic review of patient educational efforts and review of the relevant literature (Wofford *et al.*, 2008), on focus groups of physicians and nurses, and on pilot testing of the modules. Content development for each module on warfarin education was led by one physician champion who then recruited clinic personnel to contribute voiceovers, imagery, animation, and video. Each module was developed with a target duration of 3 min. Commercially available, consumer multimedia computer software for digital media capture and audio recording was used for developing modules. Engagement of clinic personnel at every stage of development was important for testing of the modules, maintaining focus on cultural sensitivity and low literacy issues, and accruing team spirit around the project.

### **Patient flow and clinic integration**

After the typical INR checkup at the laboratory, the patient returns to the clinic and waits for the interpretation of and reaction to the INR result. This 5-min waiting period was recognized as an opportunity for patient education. The anticoagulation registry sheet allowed for easy viewing of past INRs, medication changes, and previously viewed modules. The nurse administered a two- to three-item survey of questions related to material covered in the previously viewed module.

*Primary Health Care Research & Development* 2012; **13**: 42–47

With a module duration of only 3–5 min, the nurse could monitor that the device was secure and that the patient was successfully navigating the presentation, while performing other nearby nursing tasks. There was no designated area in the clinic for viewing the presentation, and the viewing most often took place in chairs located near the nurse/checkout station. The white headphones and colorful silicon device cover made it obvious to clinic personnel of the patient's activities. When the handheld computer device was retrieved by the patient, the nurse documented on the yellow registry sheet that module the patient had viewed.

### **Equipment and software maintenance**

With an average use of five times a day in a busy clinic, the two iPod Touch™ (Apple Computer, Cupertino, CA, USA) devices with silicon covers proved durable. No damage to the two devices occurred during the four-month project, and only occasionally an individual module was accidentally deleted by an errant hand gesture. The handheld devices were prominently displayed at the central nursing station for availability and security reasons. Charging of the devices once weekly was sufficient for the entire week. The earbuds continued to function well despite routine cleaning with alcohol wipes before each patient use.

### **Patient acceptability**

After all three modules had been completed, a seven-item questionnaire was administered by a staff clinician or nurse at the time of the next INR checkup. Patients were asked to rate their past warfarin educational experience (before viewing these educational modules (10-point Likert scale) (1 – not helpful to 10 – very helpful), as well as their experience with current warfarin modules (1 – not helpful to 10 – very helpful). Similarly, patients were asked about the sound and video quality of the videos (1 – poor to 10 – excellent), and the amount of time it took to watch the modules (1 – extended my visit to 10-did not extend length of my visit), and their interest in watching future modules on other medical conditions (1 – no to 10 – yes).

### **Statistical analysis**

We used Bento (Cupertino, CA, USA) for data entry and JMP-SAS (Cary, NC, USA) for

statistical analysis. We assessed uptake of the iPod™ strategy by comparing the proportion of patients who experienced the educational module with those eligible for the module (ie, patients who had had the INR tested). We determined the proportion of patients who completed the final survey after viewing all three modules (ie, graduated from the program).

Despite our intention to analyze responses to the questions posed before each module presentation, this data collection was challenged by (i) the inability to truly determine what the patient knew beforehand using a short survey; and (ii) the difficulty nurses experienced in performing this data collection and documentation in a busy clinic. Owing to incomplete and unreliable data, we did not analyze these data.

A major goal of the project was to assess sustainability, and practicality of clinic implementation. We did not formally assess attitudes of nurse or clinicians toward the modules, as only five nurses were involved in the intervention, and clinicians were unaware of the educational intervention. However, we did continue the intervention after data collection had stopped in order to see how long the intervention would last. We did not assess the impact of the educational intervention on subsequent INR values, or clinical outcomes such as bleeding or recurrent thromboembolic events.

## Results

A total of 176 patients were active on the warfarin registry at some point during the four-month study. Twenty-nine patients were added to the registry during the course of the study. Twenty-one patients had no activity (neither INR visits, nor evidence of module viewing) on the registry over the four months of the study. Chart review after the study was completed revealed that these patients had already completed warfarin therapy ( $n=2$ ), had transferred care to another practice or nursing home ( $n=24$ ), had INR monitoring performed at home or at another facility ( $n=22$ ), were admittedly noncompliant with INR checkups ( $n=23$ ), had special medical conditions ( $n=21$ ), no explanation was apparent ( $n=22$ ), or were lost to follow-up from clinic ( $n=26$ ). At baseline, registry patients (55% female, mean age 53.4 years ( $\pm 15.8$ )) had the following indications

for anticoagulation (atrial fibrillation – 33%, venous thromboembolism – 45%, mechanical heart valves – 10%, other – 20%).

A total of 130 patients had at least one INR performed at our clinic during the four months, and 20 patients had three or more INR checkups. Of the 130 patients who had at least one INR performed and were thus eligible for a patient educational module, 91 patients (70%) experienced at least one educational module. Twenty-two patients (17%, 22/130) completed all three modules, nine patients refused to view at least one module, and eight patients had at least three INR checkups but no modules were documented. Chart review of these patients showed that four of these patients had a cerebrovascular accident, tongue cancer, or a chronic pain syndrome that interfered with their care.

On the basis on the final survey of 22 patients who completed all three modules, the audio and visual quality was reported as excellent (9.0/10). Patients reported their educational experience with the computer modules as helpful (7.4/10) compared with their previous warfarin education (6.3/10). According to patients, the handheld computer strategy extended the INR visit duration by 1–5 min at most.

Neither of the two handheld computer devices was lost or stolen, and no physician time was used in this routine educational activity.

## Discussion

Reinforcement for improving educational strategies comes from accrediting bodies that mandate better anticoagulation management (National Patient Safety Agency, 2006; The Joint Commission, 2008). Nevertheless, efforts to educate patients about anticoagulation with warfarin have not been universally implemented because of logistical challenges, and the doubts about the effectiveness of patient educational strategies (Newall *et al.*, 2005; van Walraven *et al.*, 2006; Wofford *et al.*, 2008). Our educational intervention offers one means of standardizing the educational message, better accomplishing the educational task, and improving clinic efficiency at the same time.

The sustained and successful implementation of this popular technology for the purposes of patient education in this office practice reflects

*Primary Health Care Research & Development* 2012; **13**: 42–47

two interwoven ideas – the systematic delivery of an educational program to all patients attending the anticoagulation clinic, and a demonstration that videos covering open ‘bite-size’ topics can be produced and delivered in a low-cost, patient-friendly way with minimal impact on clinic operations. We judged our project to be successful because a large number of patients viewed the educational modules with the handheld computer, the responses from the graduates of the program were positive, and as important, the new strategy was a sustained improvement over our previous educational practices. One year after data collection ended, the warfarin modules were still in use, with the same devices, and additional modules for other patient educational tasks have been created.

Compared with our previous model of computer-assisted patient education that used a stationary desktop computer in a dedicated room, the handheld multimedia computer (iPod™) represents a major improvement (Wofford *et al.*, 2001, 2005; Miller *et al.*, 2005). The small size of the device and headphones makes the strategy less disruptive to patient flow and offers a practical means of providing a private educational experience. Furthermore, the educational device provided a visible, trendy innovation that nurses and patients were proud to take part in.

Although the novelty of the device and presentation seemed the focal point of the intervention, re-engineering clinic processes around the iPod was equally important. First, the prior existence of a registry facilitated patient identification, and provided a means of module tracking. Second, the process was reflexive, in effect, a standing order for the clinic, which did not depend on a physician’s orders or actions to judge whether a patient might benefit from an educational module. The prompt to use the module was built into the patient flow of the INR monitoring process, and the intervention was carried out by the nurses. Our confidence in divorcing this educational process from usual clinical care was partly due to well-developed guidelines on educating the anticoagulated patient (Sawicki, 1999; Ansell *et al.*, 2008), but also because this routine educational task could easily be delegated to a computer-assisted approach. Third, we took advantage of wait times, an issue that frustrates patients and providers alike, by providing a meaningful activity (Anderson *et al.*, 2007).

*Primary Health Care Research & Development* 2012; 13: 42–47

The limitations of our study deserve discussion. First, it is painfully obvious that not enough INR checkups were done. It could be argued that time might have been better spent tracking patients who did not appear on time for their INRs than on patient education. Had we extended the time of the study, we undoubtedly would have captured and graduated more patients through the educational series. However, noncompliance with INR monitoring is common and is as high as 30% in some studies (Kimmel *et al.*, 2007). Second, we did not assess baseline knowledge, and measuring knowledge at each stage of the process was challenging; this was attributable to the limited nursing manpower and the fast pace of care in this clinic, but also because discerning previous knowledge from that learned from the intervention alone is difficult. Given the older age and comorbidities of patients with indications for anticoagulation, such an intervention might have different effectiveness in younger, more electronically sophisticated or less sickly patient populations. Finally, the observational design, lack of a control group and focus on educational rather than clinical outcomes also limits the strength of the conclusions that can be drawn.

The best means of providing relevant patient education in the office will continue to evolve with changing technology and communication preferences. Whether medical professionals are able and willing to keep up with these changes may determine how relevant they are in patient’s clinical decisions (Blumenthal, 2002; Hawn, 2009). Additional studies including randomized controlled trials and or cost–effectiveness analysis are needed for better proof of whether these efforts at patient education can also translate into improvement in clinical outcomes for patients.

## Acknowledgments

This study was not supported by any funding. NRD, SS, SFS, DPM, and JLW were responsible for the initial conception and design; NRD, SFS, and JLW acquired the data, which were analyzed and interpreted by all authors; JLW drafted the manuscript, which was critically revised by all authors; NRD and JLW were responsible for statistical analyses; NRD, SFS, and JLW supervised the project.

## References

- Anderson, R.T., Camacho, F.T. and Balkrishnan, R.** 2007: Willing to wait? The influence of patient wait time on satisfaction with primary care. *BMC Health Services Research* 7, 31–35.
- Ansell, J., Hirsh, J., Hylek, E., Jacobson, A., Crowther, M. and Palareti, G.** 2008: Pharmacology and management of the vitamin K antagonists: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). *Chest* 133, 6 Suppl, 160S–98S.
- Blumenthal, D.** 2002: Doctors in a wired world: can professionalism survive connectivity? *Milbank Quarterly* 80, 525–46.
- Budnitz, D.S., Shehab, N., Kegler, S.R. and Richards, C.L.** 2007: Medication use leading to emergency department visits for adverse drug events in older adults. *Annals of Internal Medicine* 147, 755–65.
- Committee on Quality Health Care in America, Institute of Medicine.** 2001: *Crossing the quality chasm: a new health system for the 21st century*. Washington, DC: National Academy Press.
- Davis, N.J., Billett, H.H., Cohen, H.W. and Arnsten, J.H.** 2005: Impact of adherence, knowledge, and quality of life on anticoagulation control. *Annals of Pharmacotherapy* 39, 632–36.
- Edwards, M., Myfanwy, D. and Edwards, A.** 2009: What are the external influences on information exchange and shared decision-making in healthcare consultations: a meta-synthesis of the literature. *Patient Education and Counseling* 75, 37–52.
- Fang, M.C., Machtiger, E.L., Wang, F. and Schillinger, D.** 2006: Health literacy and anticoagulation-related outcomes among patients taking warfarin. *Journal of General Internal Medicine* 21, 841–46.
- Gurwitz, J.H., Field, T.S., Harrold, L.R., Rothschild, J., Debellis, K., Seger, A.C., Cadoret, C., Fish, L.S., Garber, L., Kelleher, M. and Bates, D.W.** 2003: Incidence and preventability of adverse drug events among older persons in the ambulatory setting. *Journal of the American Medical Association* 289, 1107–16.
- Hawn, C.** 2009: Take two aspirin and tweet me in the morning: how Twitter, Facebook, and other social media are reshaping health care. *Health Affairs (Millwood)* 28, 361–68.
- The Joint Commission.** 2008: Preventing Errors Relating to Commonly Used Anticoagulants. Applicable Joint Commission Standards. Retrieved 11 November 2010 from [http://www.jointcommission.org/NewsRoom/PressKits/Preventing+Errors+Relating+to+Commonly+Used+Anticoagulants/applicable\\_standards.htm](http://www.jointcommission.org/NewsRoom/PressKits/Preventing+Errors+Relating+to+Commonly+Used+Anticoagulants/applicable_standards.htm).
- Kimmel, S.E., Chen, Z., Price, M., Parker, C.S., Metlay, J.P., Christie, J.D., Brensinger, C.M., Newcomb, C.W., Samaha, F.F. and Gross, R.** 2007: The influence of patient adherence on anticoagulation control with warfarin: results from the International Normalized Ratio Adherence and Genetics (IN-RANGE) Study. *Archives of Internal Medicine* 167, 229–35.
- Krishna, S., Balas, E.A., Spencer, D.C., Griffin, J.Z. and Boren, S.A.** 1997: Clinical trials of interactive computerized patient education: implications for family practice. *Journal of Family Practice* 45, 25–33.
- Miller, D.P., Kimberly, J.R., Case, L.D. and Wofford, J.L.** 2005: Using a computer to teach patients about fecal occult blood screening: a randomized trial. *Journal of General Internal Medicine* 20, 984–88.
- National Patient Safety Agency.** 2006. Actions that can make anticoagulant therapy safer. Retrieved 11 November 2010 from <http://www.nrls.npsa.nhs.uk/resources/clinical-specialty/medicine/?locale=en&entryid45=59814&p=2>.
- Newall, F., Monagle, P. and Johnston, L.** 2005: Patient understanding of warfarin therapy: a review of education strategies. *Hematology* 10, 437–42.
- Østbye, T., Yarnall, K.S., Krause, K.M., Pollak, K.I., Gradison, M. and Michener, J.L.** 2005: Is there time for management of patients with chronic diseases in primary care? *Annals of Family Medicine* 3, 209–14.
- Sawicki, P.T.** 1999: A structured teaching and self-management program for patients receiving oral anticoagulation: a randomized controlled trial. Working Group for the Study of Patient Self-Management of Oral Anticoagulation. *Journal of the American Medical Association* 281, 145–50.
- Tang, E.O., Lai, C.S., Lee, K.K., Wong, R.S., Cheng, G. and Chan, T.Y.** 2003: Relationship between patients' warfarin knowledge and anticoagulation control. *Annals of Pharmacotherapy* 37, 34–38.
- van Walraven, C., Jennings, A., Oake, N., Fergusson, D. and Forster, A.J.** 2006: Effect of study setting on anticoagulation control: a systematic review and metaregression. *Chest* 129, 1155–66.
- Wofford, J.L., Currin, D., Michielutte, R. and Wofford, M.M.** 2001: The multimedia computer for low-literacy patient education: a pilot project of cancer risk perceptions. *Medscape General Medicine* 3, 23–26.
- Wofford, J.L., Smith, E.D. and Miller, D.P.** 2005: The multimedia computer for office-based patient education: a systematic review. *Patient Education and Counseling* 59, 148–57.
- Wofford, J.L., Wells, M.D. and Singh, S.** 2008: Best strategies for patient education about anticoagulation with warfarin: a systematic review. *BMC Health Services Research* 8, 40.
- Yarnall, K.S., Pollak, K.I., Ostbye, T., Krause, K.M. and Michener, J.L.** 2003: Primary care: is there enough time for prevention. *American Journal of Public Health* 93, 635–41.
- Zeolla, M.M., Brodeur, M.R., Dominelli, A., Haines, S.T. and Allie, N.D.** 2006: Development and validation of an instrument to determine patient knowledge: the oral anticoagulation knowledge test. *Annals of Pharmacotherapy* 40, 633–38.