

A New Internet-Based Learning Resource for Internal Medicine Residents

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Background

For many residents in busy postgraduate programs, clinical rotations account for the bulk of their educational experience. Recent literature has demonstrated that multimedia learning resources can be effective in improving clinical skills,^{1,2} and there is increasing utilization of the Internet to deliver the resources.³⁻⁶ Electronic resources are highly rated by learners.⁷⁻⁹ We recently developed an Internet-based, multimedia learning resource that targeted the specific learning needs of internal medicine residents. This resource, known as e-Res, is resident-centred, with easy accessibility and curriculum management capabilities. The primary objective of this article is to describe the development of e-Res, and the secondary objective is to report on resident utilization.

Methods

Setting

The University of British Columbia (UBC) Internal Medicine Program provides 3 years of core residency training. There were 81 residents in 2005–2006 (31 PGY1, 31 PGY2, and 19 PGY3) and 95 in 2006–2007 (35 PGY1, 32 PGY2, and 28 PGY3). The resident number in each training year was determined based on funding available from the university. We provided secure, personalized access to e-Res for all residents in our program from 2005 onwards. Resident enrolment and use of e-Res was encouraged primarily by making the website the most convenient (and occasionally only) method by which resources were available. We collected usage data from March 1, 2005, to May 4, 2007. We received approval from the residency training committee for developing e-Res and reporting the related findings in this article.

Assessment of Learning Needs

We initially conceived e-Res as a convenient repository of commonly cited learning materials, including landmark reference articles, presentations from academic half-days (AHDs), educational noon rounds, and audiovisual materials on various medical expert topics. Through discussion with residents, the key content modules of e-Res were identified (Table 1). This informal method of evaluating learning needs is a commonly acceptable method.^{10,11}

The ongoing learning needs assessment process for e-Res was cumulative and integrative. The e-Res subcommittee consisted of a webmaster, four chief medical residents, and the associate program director. This subcommittee reported to the AHD committee, the main curriculum management body of the residency program. The AHD committee membership consisted of an additional 12 resident

representatives from the 3 training years, all of whom provided feedback for the e-Res group.

Since its inception, e-Res content domains have changed substantially (see Table 1). The original modules were expanded and new modules added in response to feedback from e-Res users. Based on resident input, by 2007 we identified the following major areas of learning needs to be highlighted in e-Res: AHD lecture slides, notes, and supporting materials; resources specific to the general medical clinical teaching unit (CTU) rotation, such as educational schedules, noon rounds presentations, and papers cited in morning report; a reading syllabus for each internal medicine subspecialty rotation as determined collaboratively by residents and subspecialty faculty; commonly cited journal series relevant to internal medicine, including links to medical guideline websites and other medical education resources; and advice and dates important to residents enrolled in the residency program. All copyrighted materials were obtained through the UBC health sciences library, which possessed a site license for UBC resident use on educational basis. We wanted e-Res to be a resource for active learning, and therefore incorporated principles emphasized in several electronic learning reviews.^{12,13} For instance, the Auscultation Centre was added featuring a collection of cardiac murmur audio files to address a commonly identified learning need.¹⁴

Technical Requirements and Webpage Design

We used the World Wide Web Course Tools (WebCT) program and created a password-protected interface to house e-Res. The webmaster and chief medical residents are able to easily update and manage the curriculum content with at least three updates per week.

Statistical Analysis

Descriptive statistics were used to report the overall usage and trend of utilization across different training levels. We evaluated each content module and the specific items within each module based on frequency of access, measured by the number of actual visits or hits. Actual usage was expressed in mean and median log-ins per resident per training year over the study period. A clinical epidemiologist reviewed all statistical analyses. All analyses were performed using SPSS 11.0 statistical software package (SPSS Inc. Chicago, IL).

Results

In 2006–2007, 80% signed up for a personalized account on e-Res. The PGY1 and 2 classes had high sign-up rates of 85.7% and 87.5%,

Table 1. E-Res Curriculum Content

| Original Content (2005) | Revised Content (2007) |
|--|--|
| 1. Academic Half-Day Resources <ol style="list-style-type: none"> Presentation slide shows Lecture notes | 1. Academic Half-Day Resources <ol style="list-style-type: none"> Presentation slide shows Lecture notes Journal articles relevant to lecture material Problem-based learning cases/annotated answers |
| 2. Articles Collection <i>Subspecialty Landmark Articles</i> <i>Journal Series</i> <ol style="list-style-type: none"> <i>Journal of American Medical Association (JAMA) Rational Clinical Examination Series</i> User's guide to the medical literature | 2. Articles Collection <i>Subspecialty Articles</i> <ol style="list-style-type: none"> Landmark articles <i>Annals of Internal Medicine</i> subspecialty updates <i>Journal Series</i> <ol style="list-style-type: none"> <i>JAMA</i> Rational Clinical Examination Series User's guide to the medical literature <i>Annals of Internal Medicine</i> Quality Series <i>Annals of Internal Medicine</i> Health Economics Series |
| 3. Discussion Forums | 3. Auscultation Centre |
| | 4. General Medical Clinical Teaching Unit Resources <ol style="list-style-type: none"> Medical student educational materials Resident teaching session materials Weekly educational schedules Week in review educational synopsis Articles discussed in morning reports Noon rounds presentation slide shows |
| | 5. Important Dates and Advice <ol style="list-style-type: none"> Important Dates Fellowship Match Advice |

respectively, whereas the PGY3 class had lower rate (64.3%).

From March 1, 2005, to May 4, 2007, there were a total of 3,088 actual visits or hits registered in the five content modules within e-Res. The Articles Collection section had the greatest usage, with a total of 987 hits (32%), followed by the AHD and CTU sections (Figure 1). A subgroup

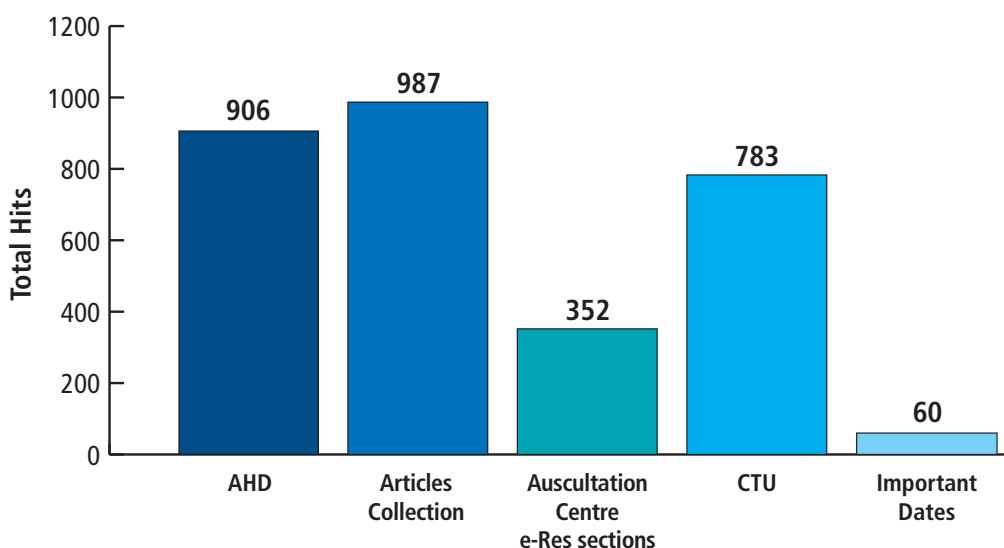


Figure 1. Number of hits for each e-Res content module. AHD = academic half-day; CTU = clinical teaching unit.

analysis was performed for the 309 items within the Articles Collection section: 47.2% were review articles, 25.2% original papers, 25.2% physical examination articles, and 2.3% medical education articles. The physical examination articles received 41.6% of all hits, while review articles received 38.3%, original research articles 17.9%, and medical

education articles 2.2%. The section with the most hits per item was on Important Dates (30 hits/item for two items), followed by CTU (6.9 hits/item for 114 items), AHD (6.3 hits/item for 143 items), Auscultation Centre (5.8 hits/item for one item), and Articles Collection (3.2 hits/item for 309 items). Although there were only two items in the Important Dates section, these items received a disproportionately high number of hits.

The mean log-ins per resident per training year over the study period were 127 log-ins for PGY1, 85 log-ins for PGY2, and 60 log-ins for PGY3 residents (Figure 2).

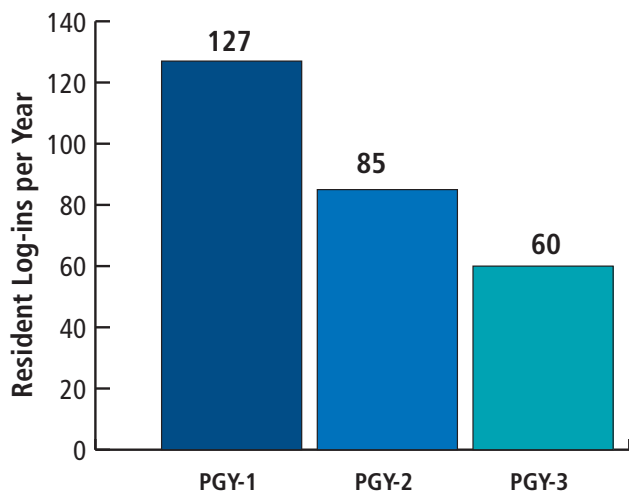


Figure 2. Relationship between e-Res usage and year of residency.

The median log-ins per resident per training year were 93 for PGY1, 66 for PGY2, and 42 for PGY3. The junior residents had increased usage of e-Res compared with the senior residents.

Discussion

Since the inception of e-Res, new groups of residents had expanded the curriculum content to respond to their changing learning needs. The actual usage has increased over time, especially among the newest generation of residents. Median hits per resident (per year) increased steadily from the current PGY3 class (42), to the PGY2 class (66), and up to the current PGY1 class (93). The increase in resident uptake mirrored the increase in amount of content on e-Res, and might be related to residents finding the available learning materials more useful. Other possible reasons include increased role modelling (junior residents witnessing their senior colleagues using e-Res) or informal advertising of e-Res by the chief medical residents at program gatherings like AHD.

The most popular e-Res section was the Articles Collection, which provided a succinct reading list contained in a single easily accessible website. Although all residents had access to medical journals via the university library, they chose to access articles using e-Res instead. This finding speaks to the ease of accessibility and user-friendliness of e-Res. The next most popular sections were related to the AHD and CTU, both core activities for residents, which likely explains the popularity. Residents did not use the electronic discussion forum, probably because they preferred the greater ease, clarity, and educational utility of oral rather than electronic discussion.¹⁵

The value of an immediately available, convenient collection of resources should not be understated. Being able to immediately learn and apply a solution to a real clinical problem can precipitate an effective learning event.¹⁶ In addition, our residency training program is rapidly expanding and not all distributed teaching sites might have the capacity of live video-conference broadcast. Therefore e-Res provided a virtual venue whereby presentations and related learning materials could be posted and reviewed at each resident's convenience, regardless

of the resident's physical location and the time of day, as long as an Internet connection was available.

There were challenges associated with the development of e-Res. First, the Auscultation Centre was not used as frequently as anticipated. Given that files in the audio library were well labelled and easily accessible, it is unlikely that the low usage was due to difficulty in accessing the desired file. Rather, residents might not appreciate the value in simulated physical findings outside of the clinical context. The challenges of focusing on multimedia technology were described previously.¹⁷ The uptake might improve if the audio files were placed within a case-based setting, although the process might be time consuming.¹⁸ Second, despite a steady increase in usage from year to year, resident uptake of e-Res remained inconsistent. Some residents visited e-Res almost daily, whereas others used it rarely, if at all.

We also did not track the amount of time spent viewing a particular page, and it is possible that a resident might open a document, and then decide it is not useful. Our main strategy to optimize resident usage thus far has been a focus on expanding and/or improving site curriculum content based on active resident input. Other strategies have included advocating the usefulness of e-Res during resident gatherings, and expanding the pool of users beyond residents to include medical students and subspecialty fellows. The latter groups have voiced their interest in obtaining access to e-Res and have found it useful based on initial informal feedback. While it is unrealistic to expect 100% of residents will use the same learning resource consistently, we hope to continue promote resident use of e-Res.

Our findings should be interpreted within some limitations. This is a local curriculum at a single site, and its generalizability to other centres is unclear. While we have captured utilization as a surrogate marker of resident uptake; we did not measure the educational impact of the utilization, such as through standardized content testing and/or practice audit.

The potential for future development of e-Res is large. It can be deployed to augment learning in distributed sites that are geographically distant, and also allows sharing and distribution of teaching presentations among residents. It may play an important role in the creation of simulated learning materials, such as in the teaching of procedural skills via online videos and demonstrations^{19,20} or in teaching around rare clinical scenarios such as unusual cardiac murmurs.¹⁴ The next step will be to relate usage to learning outcomes and/or an estimation of enhanced clinical competencies. Further studies are warranted to explore these facets.

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Examination Skills

Physical Examination of the Microcirculation

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About the Author

Margot Roach trained in mathematics/physics in New Brunswick, medicine at McGill, and biophysics at UWO. She obtained her FRCPC in 1965 and did postdoctoral studies at Oxford before taking appointments in medicine and biophysics at UWO.

She has published research on the elastic properties of arteries and the consequent changes seen in arteriosclerosis and aneurysmal disease. A pioneer in medical biophysics, she has won many prestigious teaching and research awards and is now happily retired in Tatamagouche, Nova Scotia.



Microcirculation is much harder to assess clinically than are arteries and veins. Closure of single vessels has no significant clinical effect; disease becomes apparent only when many small vessels shut down. The arterioles average 20 μm in diameter, the capillaries 8 μm , and the venules 30 μm . The arterioles, like the arteries, diverge as they branch and so get smaller, while the venules converge and get larger like the veins. Mall (quoted by Burton¹) noted that, in the mesenteric circulation in the dog, there are 40 large arteries with 600 main branches, 1,800 terminal branches, 40×10^6 arterioles, 1.2×10^9 capillaries, 80×10^6 venules, 1,800 terminal veins, 600 main veins, and 40 large veins – as one goes from the aorta to the vena cava. Other circulations will be comparable. The smallest vessels or capillaries have the thinnest walls and are therefore most permeable but also most prone to rupture. Thus, while stenosis or blockage is trivial in a single

capillary, hemorrhage is more likely to occur from the capillaries, and these are the ones most likely to bud and create new vessels that may be even more prone to rupture. This can be seen clinically in the retina as a "microaneurysm." Increased permeability to large molecules leads to hard exudates that are yellowish and often contain cholesterol, while local areas of infarction cause cotton wool spots. Both are common in diabetes and in severe hypertension, as well as in some connective tissue diseases (e.g., lupus erythematosus).

The vessels of microcirculation are too small to be seen without good magnification and transillumination, and so are studied directly mainly in the retina, the conjunctiva, and the nail beds. The retinal vessels are easiest to see as the eye is most translucent. The mesentery is easy to study at surgery but not otherwise. In all other locations, the physical examination must assess these vessels indirectly based on their function.