Applications of Quick Response (QR) Codes in Medical Education

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Medicine is rapidly evolving with the integration of new technological developments. There are great opportunities to incorporate technological marketing tools into graduate medical education (GME) to more efficiently and effectively share information. This article aims to illustrate the value of quick response (QR) codes within GME to better disperse valuable information in posters, presentations, and publications.

A QR code is a matrix bar code that stores data—most commonly URLs, text, vCards, or photos—to be quickly accessed by QR readers, available on all smartphones. QR codes have been widely used as marketing tools to efficiently guide consumers directly to online products or websites. The user simply aims the smartphone camera to scan the QR code and is directly connected to the stored data or URL embedded within the code. Because of the ubiquity of these codes in daily life, all iPhones and most Android phones have a QR reader preinstalled in the standard camera, and numerous free QR scanners can be downloaded on any smartphone. QR codes can be adopted in medical education to direct learners to online resources selected by the educator.

QR codes have not been used routinely in GME teaching and assessment. Although the first QR code was invented in 1994, the general public could not access them until more recently. While the iPhone was developed in 2007, only 35% of the US adult population owned a smartphone in 2011, significantly limiting the accessibility to QR codes.[1] However, in 2018, 81% of the US population and 96% of 18- to 30-year-olds in the United States owned a personal smartphone. Thus, access is now nearly universal across US GME. Furthermore, iOS 11 beta was released in September 2017, which incorporated QR scanners into all iPhone cameras; Android similarly followed suit, increasing access to QR codes in 2018.

QR codes can add tremendous impact to poster presentations at conferences. Evidence has shown that learners' performance increases with the use of video as adjuvant educational material[2] because videos can focus attention, efficiently present information, simplify complex concepts, and evoke emotional responses, all of which likely contribute to increased retention.[3] Rather than embedding pictures on a poster, a QR code allows conference attendees to access videos that presenters have linked to their posters. This tool expands the transmission of information in static 2-dimensional posters. It incorporates multimedia presentations that strengthen the educational value of the poster by sharing slideshows or videos of unusual case reports, surgical techniques, or other video-dependent information. FIGURE 1 shows how QR codes depict video footage from flexible nasolaryngoscopy to demonstrate vocal fold abnormalities in a poster presentation. Additionally, QR codes provide helpful resources, including the presenter's vCard, contact information, references, supplemental information, or feedback surveys.

Beyond posters, QR codes can augment the educational content of lecture presentations by: (1) quickly guiding learners toward resources to prepare for lectures, and (2) reinforcing information by linking relevant articles, videos, or other lectures. FIGURE 2 demonstrates how QR codes in PowerPoint lectures can direct the audience to videos of clinical pathology. QR codes can also link to active surveys, polls, or discussion boards to gauge learners' engagement and content understanding. QR codes in presentation slides can direct audiences to surveys, either multiple-choice or free text, to collect immediate feedback. Several small studies at academic teaching hospitals have found that QR readers used for trainee evaluations are associated with improved usability and more timely feedback.[4,5]

QR codes also can be integrated into print or online publications. When embedded into journal articles or textbook chapters, they can link to resources that are less effectively modeled in fixed 2-dimensional figures. Rather than commonly used photos or graphs, QR readers can show videos or active graphs and models that evolve over time. The use of the QR codes allows print and online resources to be converted interchangeably by integrating videos not previously possible on printed resources.

FIGURE 1

Utilization of Quick Response (QR) Codes in Poster Presentations

FIGURE 2

Utilization of Quick Response (QR) Codes in PowerPoint Presentations

With creativity, the applications for QR codes are extensive. Supplemental information can enhance learners' ability to prepare for lectures, consolidate material, and elicit questions for the presenter. Trainees could have QR codes on their badges that direct to evaluation surveys for ongoing, real-time performance feedback. QR codes could be embedded into clinical notes to link videos of patient ultrasounds, echocardiograms, neurological deficits, or scope examinations. They can help provide classroom facilitation in "teacherless" scenarios to prompt open discussion and peer-to-peer learning. Furthermore, they are useful in the flipped classroom or blended classroom organization where learners are provided resources to prepare prior to class discussions and then given QR prompts to discuss collaboratively in person. Because QR codes are transportable, they are ideal for clinical simulations, which academicians are using to creatively engage learners to apply knowledge and act in real-time simulated clinical scenarios.[6,7]

The process for creating a QR code is demonstrated in FIGURE 3 and summarized here in 3 steps.[8] First,

upload your resource (document, audio file, or video) to any file-sharing website, including but not limited to YouTube, Box, Dropbox, and Google Drive. The file must be compliant with the Health Insurance Portability and Accountability Act (HIPAA) prior to upload. Ensure that the privacy settings allow anyone with the link to access the file. Once uploaded, copy the unique URL of the uploaded file. Second, there are numerous free browser extensions to create your own original QR code that will link directly to the website where the file is stored. Type "QR code generator" into any web browser to find a variety of free programs. Paste the previously created URL into the program. It will produce the code that can be pasted as a photo into documents or presentations. Third, to read the QR code, aim the smartphone camera at the

FIGURE 3

How to Generate a Quick Response (QR) Code

QR code, which will automatically direct you to the stored content. If your phone does not have a preinstalled QR reader, there are many free QR reader applications available through any smartphone application store.

A potential downside of incorporating QR codes into teaching sessions is the possibility of learner distraction from critical points of discussion while the learner accesses online articles or watches videos. Another key issue is copyright and HIPAA compliance concerns. If the video is HIPAA compliant and stored in a secured storage medium, the QR simply enables faster, more reliable access. Another potential limitation is the need for Internet access in order to open embedded URLs. File size, on the other hand, is not usually a limitation to use. While the original QR codes had limited storage capabilities, current codes can store up to 4000 alphanumeric characters.[9] Perhaps the largest barrier to increased QR use is lack of familiarity with the creative possibilities of this technology on the part of educators. This article aims to demonstrate how a change in habit may open creative opportunities for growth in GME.

In conclusion, QR codes are reliable tools to increase accessibility to online resources, including videos, graphics, and immediate feedback in presentations, posters, and publications. Additionally, they may transform information sharing and promote interactivity in discussions, workshops, and simulations in teacherless, flipped, or blended classrooms.

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