Cost-Effective Remote iPhone-Teathered Telementored Trauma Telesonography

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Ultrasound is continuously becoming more cost effective and widespread, in addition to being an indispensible point-of-care (POC) resuscitative tool. As this tool becomes increasingly accessible in remote and operational settings, one frequent limitation is user inexperience. Several groups have previously studied guidance of less experienced POC providers by remote ultrasound experts using telecommunications software, often fixed within hospitals, control centers, or vehicles.[1,2] The advancement in personal telecommunication technologies and networks enables these techniques to be brought to the scene of injury or illness, limited only by a requirement for internet coverage, which is expanding worldwide.

To demonstrate both the simplicity and robustness of existing off the shelf technologies, we conducted a proof-of-concept evaluation of a telementored resuscitative (EFAST)[3] ultrasound examination. This involved an expert interpreter guiding a POC provider located mid-mountain at a commercial ski resort in the Rocky Mountains with the assistance of a healthy volunteer "patient." Ultrasound images were obtained on a first generation Sonosite 180 (Sonosite Corp., Bothell, WA) machine and converted to digital video using a analog-to-digital video converter (Monoprice, Rancho Cucamonga, CA). A head mounted 1.3 megapixel web camera (Microsoft, Redmond, WA) provided a macroscopic view of the examination allowing the remote examiner to view both the patient and examiners hands, while simultaneously viewing the ultrasound results (Figs. 1–3). Informed consent was obtained from both the simulated patient and the ultrasonographer.Video signals from the ultrasound system and a head mounted web camera were processed using a laptop computer (Lenovo ThinkPad, Hong Kong) and streamed over the internet using a standard free internet phone service known as Skype (Luxembourg City, Luxembourg). The internet connection was established using the tethering feature of the iPhone to a local 3G network. The internet provider was a standard commercial source (Telus Mobility, Vancouver, BC, Canada).

We found that the transmitted images were of excellent quality and they allowed the remote interpretation of a complete EFAST examination. Furthermore, the remote examiner was able to view the images more clearly because the POC provider's viewing was obscured by alternating bright sun and blowing snow. Thus, although the POC provider was an experienced ultrasound user, he still required remote mentoring to obtain diagnostic images. In comparison with Liteplo et al.,[4] we found the frame rate was near real time, allowing easy recognition of physiologic processes such as lung sliding. For documentation purposes, we captured the color Doppler signal from the visceral-parietal pleura to confirm lung sliding.[5] We think that in any locations on earth where internet is available, advanced ultrasound diagnoses can be made aided by remote experts. As in any trial demonstration, the challenges are upon the system directors to enable sustainability of these approaches.

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Figure 1. Screen shot from remote Calgary viewers laptop display. The scene image is captured on the left video window, whereas the right displayed the real-time streaming ultrasound video. In this instance, the power slide enhances the confidence in the realtime recognition of lung sliding, ruling out a pneumothorax.

Figure 2. Image from remote mountain side ultrasound. Dr. McBeth performs an ultrasound examination on a simulated patient at mid-mountain at a ski-resort in the Canadian Rockies using a hand-held ultrasound and head mounted webcam routed to the internet through an iPhone.

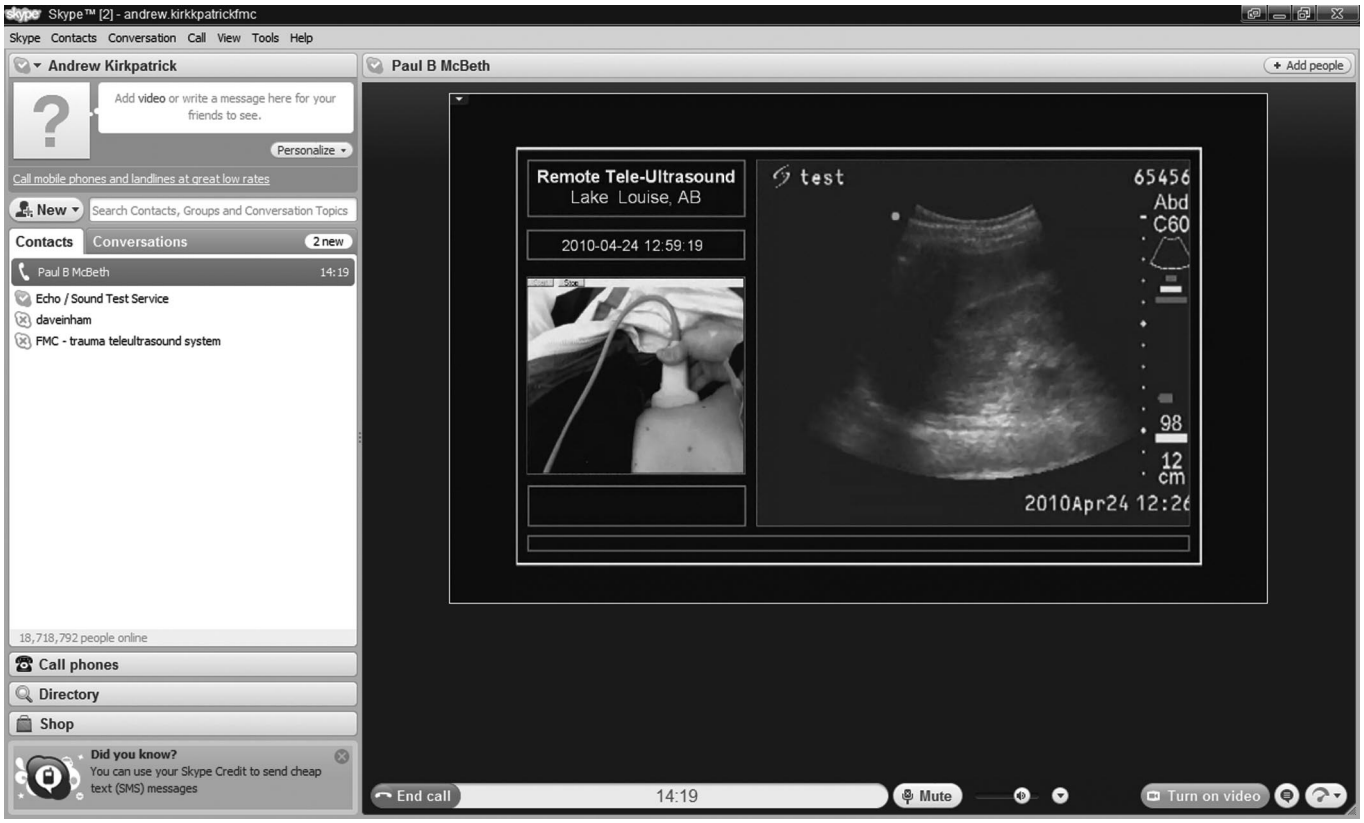

Figure 3. Screen shot from remote Calgary viewers laptop display. The scene image is captured on the left video window demonstrating the examiner holding the probe on the patient's right flank, whereas the right displayed the real-time streaming ultrasound video, in this instance the remote viewer is guiding the POC provider to optimize the splenorenal interface.

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