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Ultrasound

Reinventing ultrasound: Experience in a low-resourced setting

Philips VISIQ ultrasound system

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The transducer-based Philips VISIQ ultrasound system offers a potential turning point in healthcare for low-resourced countries. It is ultrasound that has been rethought to take into account the practical needs of emerging markets that require an affordable ultrasound system that is high-quality, user-friendly, lightweight, portable, and with wireless connectivity. In addition, an ideal system will require low power consumption and be easily serviced. The VISIQ system was evaluated at the Ernest Cook Ultrasound Research and Education Institute (ECUREI) with regard to image quality, system features, application versatility, workflow, and peripherals.* As ultrasound moves into remote settings, VISIQ – which offers high-quality imaging in a system that is lightweight and offers a long battery-life of 2.5 hours – may provide a valuable solution.

ECUREI for excellence in health training and research

Ernest Cook Ultrasound Research and Education Institute (ECUREI) is a training center for diagnostic ultrasound and other imaging modalities located in Mengo Hospital in Kampala, Uganda. Launched in July 2002, it is the first institution of its kind in East Africa and draws students from all over Africa and as far away as the United Kingdom. The vision of ECUREI is to be the epitome of excellence in health training and research. Its mission is to improve the health of Ugandans through excellent training of health personnel. Dr. Michael Kawooya, the author of this paper, is Associate Professor of Radiology and Director of ECUREI.

*Philips provided the resources needed to undertake this study.

Background

Medical imaging using ultrasound (sonography) is a non-invasive method of looking inside the human body. It is based on a pulse-echo technique in which pulses of ultrasound waves are sent into the human body and the echo reflected back is used to construct an image from inside the body.

Sonography is widely used in medicine. In emerging markets, it has become the mainstay of imaging, rapidly overtaking plain-film radiography. It has a wide variety of applications, but has gained the strongest place in obstetrics and gynecology because it is free of the complications attributed to ionizing radiation.

Globally, medical costs are rapidly rising and healthcare is becoming increasingly unaffordable in low-resourced settings. Clinical investigations such as ultrasound are necessary for accurate diagnosis and appropriate treatment. The major cost drivers of health services are made up of not only recurrent costs and human-resource related costs but also the capital costs necessary for investment in infrastructure and medical devices. Highly sophisticated and elegant medical devices demanded by patients in developed countries are often a luxury and not accessible by the majority of patients in rural areas of under-resourced countries.

Challenge

To achieve equitable healthcare worldwide, it is important that affordable imaging technologies, tailored to the needs and resources of rural communities, are developed. These technologies should be high-quality, robust, user-friendly, lightweight, easy to move from place to place, require low power consumption, have wireless connectivity to allow data transfer for consultation and e-health, and be easily serviced. This ideal combination of qualities within a medical device has been sought by many low-resourced countries.

Study objectives

It is important that a system targeted for use in emerging markets be evaluated for its fitness of purpose by potential users in that same environment in order to provide feedback to the manufacturer for further improvements.

This study set out to test the recently developed Philips VISIQ ultrasound system in a low-resourced country (Uganda).

The general objective of the study was to document aspects in the design and performance of VISIQ that indicate high image quality, versatility of application, robustness, user-friendliness, portability, and to point out components of the machine which could benefit from further improvement.

Specific objectives were to evaluate:

- Image-quality aspects of the VISIQ system, including image sharpness, contrast resolution, spatial resolution, color-flow mapping, and spectral Doppler quality
- Other non-imaging features, such as patient data entry, review, reports, exam workflow, text auto-complete function, annotation, cineloop, control panel, touch display, and other user interface features
- The versatility of the application for analysis, measurements, and calculations, including analysis of measurements and calculations for obstetrics and general abdominal applications
- Product workflow-related functions, including ease of use, intuitiveness, system mobility, and the touchscreen user interface – especially the speed of response
- Cart peripheries and other external features such as cable length

The results of the study would help the designers put out a final product that meets the clinical requirements of low-resourced countries, is affordable, and has technical quality and efficiency comparable to more sophisticated and costly machines.

It was beyond the scope of this study to test the connection to PACS since this is not available in our setting, nor was it possible to rigorously test the robustness of the machine and its performance under extreme physical conditions – including power fluctuations, rough roads and unpaved hospital pathways, or extremities of weather – and to test with operators with minimal or no computer knowledge.

Study methods

This technical assessment study was conducted in July 2013 at ECUREI in Mengo Hospital, a 350-bed hospital that scans up to 60 patients daily in the ultrasound unit. The majority of scans are for obstetrics and gynecology.

Ethical approval was given by the Mengo Hospital Research Review Committee, and informed consent was obtained from all patients before and during the examination. Patients were free to withdraw from the study at any time. Confidentiality was maintained throughout the study and no names appeared on images saved from the test machine. Identification was by a number known only to the principal investigator. No adverse effects were observed during the study period.

Participants included female and male patients ages 18 to 50. A total of 40 human subjects participated. Obstetrics, gynecology, and general abdominal procedures were performed. Patients were initially scanned using another manufacturer's ultrasound system as the "non-test" system. Patients were then scanned using the Philips VISIQ ultrasound system. The report sent to the referring clinician was based on findings from the non-test machine. An attempt was made to confirm any additional findings made using the VISIQ system by scanning the patient using another ultrasound system such as the Philips HDI 5000.

Scanning was performed by the principal investigator and two other sonographers. Predetermined remuneration was per scan. Other payments were for administrative costs and payment to the nurse who assisted in administering the informed consent. A Philips site-monitoring person was available throughout the study. The VISQ system was shipped back immediately upon study completion.

Study parameters

Transducer	Mode tested	Imaging features tested	Clinical applications	Exam type
C5-2 (INV)	2D Tissue Harmonic Imaging, M-mode, color and PW Doppler	SonoCT, XRES, iSCAN/ AutoSCAN, post processing	OB	Fetal well-being exam for out-patients and in-patients (Fetal anatomy, OB measurements, FHR, GA, EFW, biophysical profile, Doppler for umbilical artery and uterine artery, 3rd trimester exam, other relevant parameters)
C5-2 (INV)	2D Tissue Harmonic Imaging, M-mode, color, and PW Doppler	SonoCT, XRES, iSCAN/ AutoSCAN, post processing	Abdomen	Evaluate liver, gallbladder, pancreas, spleen, kidneys, urinary bladder, prostate, uterus, and ovaries

Study findings

Image quality

VISIQ was found to have good and diagnostically adequate image quality, contrast resolution, spatial resolution, color flow mapping, and spectral Doppler quality, regardless of the build of the patient, and AutoSCAN and SonoCT optimized quality. While harmonic imaging alone was not adequate to deal with speckle, SonoCT was helpful in removing speckle. Using the touchscreen, it was possible to adjust gain and to engage other functions such as color and spectral Doppler.

Non-imaging features

There was ease of patient data entry, followed by transducer and preset selection, all with the touchscreen. It was possible to review the automatically generated reports, text auto-complete function, and easily annotate. The cineloop worked efficiently and the touchscreen control panel was easily accessible, sensitive to touch, and operated smoothly. The touch display was convenient and functioned beautifully. The user interface was generally good.

Versatility of analysis application

Overall, measurements and calculations were easily performed by touchscreen. The hidden features meant that one had to become familiar with the icons and features behind the icons. The user interface is similar to that of a smartphone. Users with less computer knowledge or who are unfamiliar with smartphones may require some additional time to learn the interface.

Product workflow-related functions

The general ease of use enabled quick and smooth workflow, the light weight of this transducer-based system favored easy mobility, and the touchscreen user interface – especially the rapidity of response to touch – helped to expedite the exams.

Peripheral equipment

The stand was lightweight and sleek, and was easily and smoothly negotiated even through small spaces. It was easy to maneuver the machine in a relatively crowded in-patient ward. There was adequate life of the battery-power to allow investigation of several patients without plugging the system into a main power source. The transducer cord was shorter than we desired. The angulation of the screen was almost vertical, and the touchscreen interface meant that an upraised arm was required to use the screen. This may result in fatigue, especially for operators who are used to horizontally inclined interfaces. Based on this input, Philips designers modified the kickstand to provide the user more options to adjust the angle of the screen. In addition, frequently used icons such as “Freeze” were positioned lower on the user interface so that the user is no longer required to raise an arm to reach them.

Conclusion

The transducer-based Philips VISIQ ultrasound system possibly represents a turning point for healthcare, in which ultrasound has been rethought to take care of the needs of emerging markets by providing a high-quality yet affordable system. While some parameters such as extreme physical conditions were not able to be covered in our test, VISIQ may be the answer to the outcry from low-resourced countries for an ultrasound system that is high-quality, user-friendly, lightweight, easy to move from place to place, has a battery life of 2.5 hours, offers wireless connectivity to allow data transfer for consultation and e-health, and is easily serviced.

As ultrasound moves into new settings, high-quality imaging through this lightweight and ultra mobile system may prove valuable.

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Please visit **www.philips.com/VISIQ**

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