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Digital Cytology as the Tool for Organization of Cytology Online Quality Assurance Programs

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ABSTRACT

The article aims at evaluating the use of telecytology and laboratory information management system (LIMS) as tools for the implementation of online cytology quality assurance programs under the conditions of Georgia. Five hundred gynecological cytology cases (benign – 350; atypical squamous cells of undetermined significance (ASCUS) – 80; low-grade squamous intraepithelial lesion (LSIL) – 35; high-grade squamous intraepithelial lesion (HSIL) - 35) were randomly selected. The randomization has been done by using the Research Randomizer. Digital images were obtained in all cases at a maximum resolution of 2048x1536 pixels. Then, all 500 cases (medical data and images) were uploaded to the LIMS and were labelled "QA". Diagnosis of glass slides and digital images were made independently in a double-blind manner by three certified cytologists, commencing with the diagnosis of "QA" cases followed by a diagnosis of glass slides four months later. It was found that the diagnoses of "QA" cases correspond with initial diagnoses.

KEYWORDS

Cervical Smears, Digital Images, Laboratory Information Management System, Telecytology

INTRODUCTION

Quality assurance programs in cytology are one of the most important methods to maintain and improve the diagnostic acumen of cytotechnologists and cytopathologists, but there are difficulties in carrying out such programs. A long turnaround time for the circulation of glass slides is a major drawback. It is well known that it is prolonged in the case of a large number of participants and widely spread institutions. The use of photographed slides has been a partial, but unsatisfactory solution because of costs and delays in preparation.

Telecytology is a component of telemedicine which can be simply defined as the practice of transmitting digital images of cytology glass slides through telecommunication networks to remote viewing locations for diagnosis, storage, or education. This service is rapidly becoming an integral part of many hospitals and clinics around the world. In many programs, telecytology accounts for over 50% of all activities. Most studies of telecytology have focused on usage of robotic microscopes and online microscopy (Coleman, 2009; Farahani & Pantanowitz, 2015; Horbinski & Wiley, 2009; Kayser et al., 2008; McClintock, Lee, & Gilbertson, 2012; Rocha, Vassallo, Soares, Miller, & Gobbi, 2009; Weinstein et al., 2009). Other studies have evaluated the use of digital images of slides (Bautista & Yagi, 2010; Bruch et al., 2009; Chargari et al., 2011; Daniel et al., 2011; Evered & Dudding,

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2011; Fronza & Fronza, 2007; Furness, 1997; Hufnagl & Schluns, 2008; Mencarelli, Marcolongo, & Gasparetto, 2008). Often diagnostic accuracy tends to be high, but image quality is judged to be poor. Telepathology as an alternative modality for quality assurance in breast histopathology has been suggested by one study (Leong, Graham, Schwarzmann, & McGee, 2000). However, there is no previous study examining the application of telecytology for implementation of quality assurance programs.

There is a very clear need for the expanded application of information technology (IT) in healthcare. Clinical workflow still relies heavily on manual, paper-based medical record systems, which is economically inefficient and produces significant variances in medical outcomes. The laboratory information management system (LIMS) is at the heart of IT implementation policies in healthcare systems around the world. Most of these policies are based on beliefs about the positive value of LIMS rather than on the available empirical evidence; as a result, policy documents comprise aspirational statements rather than detailed and realistic expectations (Clamp & Keen, 2007).

It is evident and well known that the field of healthcare informatics is rapidly evolving. The new models and protocols of LIMS are developed. They are based on the implementation of profiles such as HL7 and DICOM. Despite obvious advantages and benefits, practical application of LIMS in everyday practice is slow. Research and development projects are ongoing in several countries around the world to develop medical information management systems: examples include Canada, Australia, England, the United States, and Finland (Bloom, 2009; Hayrinen, Saranto, & Nykanen, 2008; Monaco & Pantanowitz, 2015; Singh & Badaya, 2016). The medical information management system is used primarily for setting objectives and planning patient care, documenting the delivery of care, and assessing the outcomes of care. It includes information regarding patient needs during episodes of care provided by different healthcare professionals (van Ginneken, 2002). The amount and quality of information available to healthcare professionals in patient care have an impact on the outcomes of patient care and the continuity of care. The information included in LIMS has some functions in the decision-making process in patient care. It also supports decision making in management and health policy. However, there is no previous study examining the application of LIMS for telecytology and quality assurance programs. This is the first study to examine the application of telecytology and LIMS for implementation of cytology quality assurance programs under the conditions of Georgia.

MATERIALS AND METHOD

We randomly selected 500 gynecological cytology cases (benign – 350; atypical squamous cells of undetermined significance (ASCUS) – 80; low-grade squamous intraepithelial lesion (LSIL) – 35; high-grade squamous intraepithelial lesion (HSIL) - 35). The randomization has been done by application of the Research Randomizer. That is a free service offered to students and researchers interested in conducting random assignment and random sampling. This service is available at www.randomizer.org. Cases were diagnosed routinely by three certified cytologists with an experience of telecytology and usage of the laboratory information management system which provided cytology diagnoses. All participating cytologists had more than seven years of cytology and up to 2 years telecytology and usage of LIMS experience. The most worrisome cells or groups in each case were selected and marked by all participating cytologists. The slides of all mentioned 500 cases were photographed with 2.0 USB digital eyepiece microscope camera with resolution 3.0. The images had a resolution 2048x1536 pixels. The mean number of selected fields and digital images for each case were 5 (range 5-7) and 20 (range 18-22), respectively. Each series of images began with a general view (magnification x40), followed by higher magnification (x100) of diagnostically interesting areas as directed by the cytologist. The digital images were taken by an experienced cytopathologist. The images were stored in a personal computer and uploaded to laboratory information management system together with necessary medical data. Created cases were labeled “QA”.