

Internet-Based Digital Simulation for Cleft Surgery Education: A 5-Year Assessment of Demographics, Usage, and Global Effect

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BACKGROUND: In October 2012, a freely available, internet-based cleft simulator was created in partnership between academic, nonprofit, and industry sectors. The purpose of this educational resource was to address global disparities in cleft surgery education. This report assesses demographics, usage, and global effect of our simulator, in its fifth year since inception.

OBJECTIVE: Evaluate the global effect, usage, and demographics of an internet-based educational digital simulation cleft surgery software.

SETTING AND PARTICIPANTS: Simulator modules, available in five languages demonstrate surgical anatomy, markings, detailed procedures, and intraoperative footage to supplement digital animation. Available data regarding number of users, sessions, countries reached, and content access were recorded. Surveys evaluating the demographic characteristics of registered users and simulator use were collected by direct e-mail.

RESULTS: The total number of simulator new and active users reached 2865 and 4086 in June 2017, respectively. By June 2017, users from 136 countries had accessed the simulator. From 2015 to 2017, the number of sessions was 11,176 with a monthly average of 399.0 ± 190.0 . Developing countries accounted for 35% of sessions and the average session duration was 9.0 ± 7.3 minutes. This yields a total simulator screen time of 100,584 minutes (1676 hours). Most survey respondents were surgeons or trainees (87%) specializing in plastic, maxillofacial, or general surgery (89%). Most users found the simulator to be useful

(88%), at least equivalent or more useful than other resources (83%), and used it for teaching (58%).

CONCLUSIONS: Our internet-based interactive cleft surgery platform reaches its intended target audience, is not restricted by socioeconomic barriers to access, and is judged to be useful by surgeons. More than 4000 active users have been reached since inception. The total screen time over approximately 2 years exceeded 1600 hours. This suggests that future surgical simulators of this kind may be sustainable by stakeholders interested in reaching this target audience. (J Surg Ed ■■■■-■■■. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEYWORDS: cleft, simulation, simulator, digital, education, training

COMPETENCIES: Practice Based Learning And Improvement, Patient Care And Procedural Skills

INTRODUCTION

Cleft lip and palate anomalies are the most common congenital defects affecting the face worldwide.¹ The frequency of these facial anomalies is reported as 1 in every 500 to 700 births on average,² and is variable in different populations based on demographic, socioeconomic, and geographical factors.³ Cleft lip and palate anomalies can result in inadequate nutritional intake, recurrent respiratory and ear infections, hearing impairment, airway obstruction with difficulty breathing, esthetic disfigurement and speech dysfunction.⁴ It is, therefore, not surprising that when left unrepaired, cleft lip, and palate defects can result in increased patient morbidity and mortality, as well as significant social isolation.⁵

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Surgical repair of cleft deformities has been shown to improve patient survival, feeding and speech,⁶ as well as result in immense economic benefits for communities of affected patients through successful reintegration into the workforce.⁷ However, many patients with facial cleft deformities reach adulthood without undergoing surgical repair.

Global barriers to surgical cleft care are multifaceted but can be largely attributed to lack of financial resources or surgical expertise. Financial limitations are especially significant in developing regions of Africa, South America, Asia, and the Middle East where patient travel costs and lack of a financial support system were found to be the most important barriers to cleft surgery.⁸ The absence of adequately trained surgeons in areas with an unmet surgical burden is another compounding barrier to equitable global cleft care. In developing countries, surgical training programs tend to be less formalized, with trainees performing and observing a limited number of cases. Training programs in developed countries on the other hand, usually have a higher surgical volume⁹ as well more educational opportunities available to trainees. Surgical trainee experience in developed countries, however, is also limited, mostly due to strict work-hour limitations and mandatory faculty supervision.¹⁰

Volunteer international surgical initiatives provide qualified surgical experience, and can be valuable educational learning experiences where local or international surgical trainees can observe or participate under supervision in a high number of surgical cases. However, the long-term sustainability of these initiatives remains a challenge and concern to their success.¹¹ To address the global disparities in surgical cleft care, the senior authors (C.B.C. and R.L.F.) have developed an educational, freely available, and internet-based cleft surgery simulator. The purpose of this educational resource is to address the financial and educational barriers to comprehensive global cleft care in developed and developing countries. We have previously described the simulator content and preliminary usage characteristics in its first year of activity.¹² In this study, we report the demographics of users, usage patterns and global effect of our cleft surgery simulator, currently in its fifth year since inception.

MATERIALS AND METHODS

Simulator Development and Content

In October 2012, partnership between the senior authors (C. B.C. and R.L.F.), the nonprofit organization Smile Train and the biotechnology company BioDigital Inc. resulted in the creation of an educational cleft surgery simulator.¹² The simulator is freely available online at www.cleftsim.org, is compatible with frequently used Internet browsers (Google Chrome and Mozilla Firefox), and is available in English,

Chinese, Spanish, Portuguese, and French. Donations from the Smile Train organization provided funding for simulator development and maintenance.

The educational material covered through the simulator includes three-dimensional (3D) digital animations, with text as well as voice over surgeon commentary, of normal and pathologic anatomy, surgical markings, and detailed steps of fundamental cleft procedures (Fig. 1). Unilateral and bilateral cleft lip, cleft palate, and pharyngeal anatomy modules are covered. Surgical markings and detailed procedural modules of the Mohler unilateral cleft lip, cutting retrograde bilateral cleft lip and cleft palate, Furlow double opposing Z-plasty cleft palate, pharyngeal flap, and Dibbell/Tajima cleft rhinoplasty repairs are also included. More recently, modules detailing velopharyngeal anatomy, palatal fistulas, and the facial artery musculomucosal flap procedures were added. The procedural modules include high-definition intraoperative footage with surgeon commentary of real patient cases highlighting the critical steps of the procedure. A test section that includes multiple-choice questions for selected modules is also available.

Data Collection and Analysis

Simulator access patterns by users were collected in real-time, using an analytics database embedded within the simulator platform. Available data included number of new users, active users, sessions, new users per month, percentage monthly new sessions, active users per month, sessions per month, and countries of origin of users accessing the simulator. User session duration in minutes is available from 2015 to date. Number of new users is defined as number of simulator registrations, whereas active users included newly registered and previous users. Data regarding simulator educational content access were also collected.

Surveys evaluating the demographic characteristics of registered users and simulator use were collected by direct e-mail. Smile Train is a philanthropic organization that supports local partner surgeons for sustainable patient cleft care in their communities. Surveys evaluating Smile Train partners' usage of the simulator and use were also collected through direct e-mail. All collected data were anonymous and de-identified. Descriptive statistical data analysis were performed using the Statistical Package for the Social Sciences (SPSS) (v. 23.0, IBM Corporation, Armonk, NY).

RESULTS

Users from a total of 136 countries accessed the simulator by June 2017 (Fig. 2A), a significant increase from 78 countries described in our 1-year report.¹² The simulator

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