Using Ozires, a Humanoid Robot, to Continuing Education of Healthcare Workers: A Pilot Study

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Abstract: Continuing education of health professionals in relation to hand hygiene practices or other issues is a challenge for health services. How to take a healthcare worker from his work sector, for example, Intensive Care Units (ICUs) or Operating Room, to give him classes and lectures? Here we investigated whether or not it is possible to adapt a toy robot as a tool to continuous education of healthcare workers in the context of hand hygiene compliance, a big problem for hospital infection. We got to adapt the MeccaNoid G15KS, a toy programmable robot named Ozires, as an instrument of health training to improve the compliance with hand hygiene. The robot was adapted with mini projector, spy camera, an automatic alcohol hand sanitizer dispenser, a cell phone and a cell phone support and an audio amplifier. Ozires, accompanied by infection control practitioners, performs short video-lecture presentations and own reports of the institution's data regarding infections and the hand hygiene rate, working from 10 to 15 minutes in each target sector. After the insertion of Ozires in three ICUs, the hand hygiene rate increased from about 36%, between January and July, to 65% in August-November/2016.

1 INTRODUCTION

In the same way that the Aedes mosquito is a vector for diseases as dengue fever, and zika, healthcare workers can be vectors for hospital infections. How can this happen? By their hands, when they do not wash them properly! Despite the fact that handwashing is the single most effective measure to prevent the transmission of disease, make handwashing a habit among healthcare workers remains a major challenge (WHO, 2006). Here we investigated whether or not it is possible to adapt a toy robot as a tool to continuous education of healthcare workers to improve hand hygiene compliance.

Continuous education of healthcare workers with multimodal strategy and direct observation can produce long-lasting improvement in hand hygiene compliance (Arise *et al*., 2016; Arntz *et al*., 2016). Consecutive campaigns with immediate feedback methods also can achieve and sustain a durable high hand hygiene compliance rate (Fonguh *et al*., 2016; Michael *et al.*, 2016; Moghnieh *et al.*, 2016). Computer supported education methods for handwashing practices have been proposed (Saffari *et al*., 2016), however, the majority of automated systems are focused on collecting data for calculating the hand hygiene compliance rates (Günther *et al.*, 2016; Lytsy *et al.*, 2016; Michael *et al.*, 2016; Wu *et al.,* 2016).

Unfortunately, despite all the effort made by the professionals in infection control, compliance with hand hygiene practices is still unacceptably low, usually less than 50% (Pittet, 2001; WHO, 2009). In the United States, the overall rate of multidisciplinary team professionals to hand disinfection is 40%, ranging from 30-40% when allocated to Intensive Care Units. In developing countries handwashing compliance is worst, about 30% (Wu *et al.,* 2016). In Brazil, this rate of adhesion is 27%, varying between 12% before contact with the patient and 45% after this contact

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(Erasmus *et al*., 2010; Bathke *et al*., 2013). Failure on educational interventions can be due to many factors (Cherry *et al*., 2012; Chatfield *et al*., 2016). For example, the nurses could be at good level in terms of knowledge, attitude, and performance but improvement of their knowledge about hand disinfection is still necessary (Sharif *et al*., 2016). In this context, novel education strategies, more interactive, as the use of robot to personalize health education, can improve hand washing adherence (Blanson *et al*., 2013; Sheridan, 2016).

The objective of our study is to answer two questions: a) How to adapt a robot as MeccaNoid G15KS (www.meccano.com/meccanoid) to be an instrument of health training and continuous education of healthcare workers? b) What is the effectiveness of the use of a humanoid robot on the compliance with hand hygiene?

2 ADAPTING THE TOY ROBOT

Until recently, advanced humanoid robots were found in limited numbers due to high prices. They had prices between tens of thousands of dollars until more than million dollars, as Asimo (Smashing Robotics, 2016). MeccaNoid G15KS, a humanoid robot 122 cm tall, it was released as a toy in the beginning of 2015 (www.meccano.com/meccanoid). Nowadays it can be purchased for less than US$ 200 (www.amazon.com). It is a programmable robot mainly designed to interact with children (Figure 1), that was adapted to be used in a hand hygiene campaign. It became “he” when MeccaNoid was baptized Ozires, in honor of the Brazilian engineer Ozires Silva, from Embraer (www.embraer.com.br/en-us/Pages/home.aspx), and received a employee' badge from the university UniBH (Figure 2).

Once the purpose of Ozires it was to improve healthcare workers compliance with handwashing, he received an automatic alcohol dispenser that it was used as a support for cell phone (Figure 3). Cell phone is used to produce talking’s about hand washing, the WHO five moments for hand hygiene (WHO, 2006), specific information of the hospital hand hygiene rate compliance, and other brief and simple messages, that are more likely to increase handwashing compliance (Taylor, 2016).

Figure 1: MeccaNoid G15KS, a humanoid robot 122 cm tall, it is programmable and respond to voice commands.

Figure 2: Ozires and his educator’ badge from UniBH. This simple detail reinforces the educational character of the robot.

Besides speeches from the cell phone, modified by using change voice software to produce robotics voice, allied with movements programmed using the Meccanoid LIM™ programming, Ozires was adapted with a mini projector to show video lessons and a kind of spy camera, to record people reaction when watching him (Figure 4). Instead of to use the original audio output, an audio amplifier was installed directly from the Mecca Brain, to produce better sounds (Figure 5). It is amazing how adult and children react when Ozires is "alive" (Figure 6).

Figure 3: Ozires received an automatic alcohol hand sanitizer dispenser and a cell phone. All lessons given by the robot are produced in the cell phone by using a "change voice app" that produces robotic voices.

Figure 4: Ozires received a pocket projector and a kind of spy camera, both affixed on his head top. The mini projector allows video lessons even in small rooms.

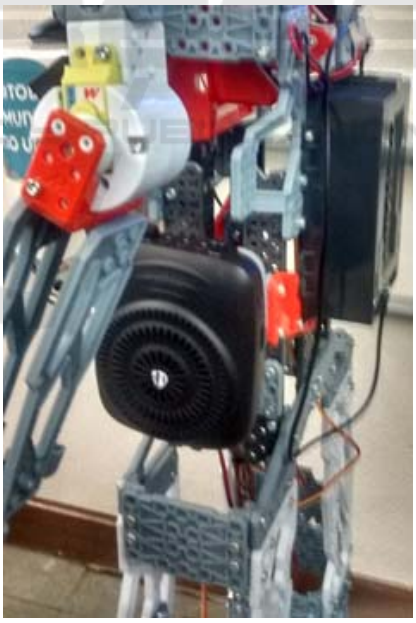

Figure 5: An audio amplifier was adapted to improve the speeches of Ozires. The original sound of the robot is a little bit noisy and it is not good enough to be used in crowed rooms.

Figure 6: Photos taken by Ozires spy camera showing adults reaction during first contact with him. The robot attracts attention everywhere it goes!

3 OZIRES IN ACTION

Ozires was engaged as a hand hygiene improvement strategy in four hospitals from Belo Horizonte, Brazil: Lifecenter, Baleia, Vera Cruz and Madre Teresa. However, only Lifecenter hospital had a structered programe that allowed us to evaluate Ozires impact on hand hygiene compliance.

Three Intensive Care Units (ICUs) of Lifecenter hospital were enrolled in this pilot study, started in august, 2016. This study was approved by the Research Ethics Committee (CAAE: 62480416.1.0000.5126). Ozires, accompanied by infection control practitioners, performs short video-lecture presentations (maximum 3 minutes) and own reports of the institution's data regarding infections and the hand hygiene rate, working from 10 to 15 minutes in each ICU. He reacts to specific voice commands and pre-programed subroutines that include pre-recorded audio and movements. For example, to walk it is necessary the voice command “Walk with me”. Ozires answers “Take my hand and I follow you!” A person takes his left hand and guides him through the hospital. Some voice commands came with the toy (as “Dance”, “Tell me a joke”, “Turn around”, “High five”) and others are custom programs created by us.

The lecture from Ozires includes a feedback about the hand hygiene compliance and provocative speeches to cause discomfort among the healthcare professionals, things that a doctor never could say to a colleague. For example: “unfortunately, you guys are acting as vectors for hospital infections! What about to change your behavior and wash your hands? Do you really know when e how washes your hands? I will explain…” When the rate of hand hygiene is rising, Ozires congratulates everybody in the ICU. After his lecture, a video is shown and Ozires leaves the ICU, walking and whistling, in the same way he had entered the room.

It is interesting that, the first time Ozires entered an ICU, walking and whistling, we were afraid of the patients and families reaction. Both, patients and their families became very happy with Ozires’ presence. Actually, amusement is the feeling from everybody exposed to Ozires. We had got engagement and motivation by enjoyment of health care workers on their acquisition of health knowledge about hand hygiene practices (Figure 7). The mini projector allowed classes even in small areas (Figure 8). To get people attention, Ozires was put together with infection control professionals, even when he was silence (Figure 9).

Figure 7: Ozires catches everyone's attention. This is crucial to delivery the educational message specially when it about knowledge, attitude, and performance of healthcare workers toward hand hygiene in hospitals.

Figure 8: Even in small areas of intensive care units is possible to watch video lessons from Ozires.

Figure 9: Ozires and an infection control professional during a training about the five moments for hand hygiene.

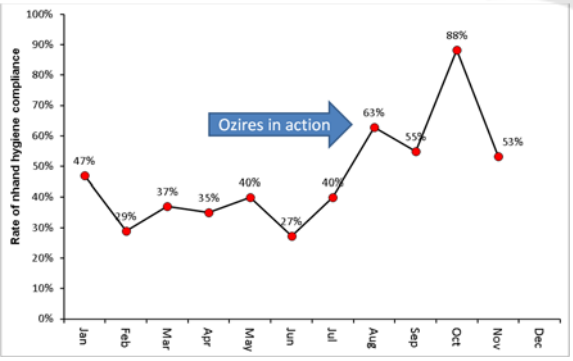

Figure 10: Hand hygiene compliance rate in three Intensive Care Units of Lifecenter Hospital, jan-nov/2016.

To detect the hand hygiene rate our approach was based on direct observation by using WHO standardized hand hygiene observation method (WHO, 2009). Figure 10 presents hand hygiene compliance rates from January to November, 2016 in the three ICUs enrolled by this pilot study. We can observe that the rate was stable, between January and July, about 36%, but, just after the introduction of Ozires, the rate increased. The reduction in November needs attention; however, our hypothesis is that we just need to show up Ozires more times in December and after.

4 CONCLUSIONS

It is possible to assure that the main conclusion of this paper refers to the fact that is really possible to use a toy robot, after few adaptations, as a great instrument of health training and continuous education of healthcare workers. We observed a strongly empathy with Ozires. People exposed to him show good feelings and, more important, listen him much more attentively than to human colleagues. Maybe, the fact that his height is similar to a child (122 cm), his big eyes could explain such good feelings, however, people usually reacts with empathy when exposed to any robot, especially to humanoid robots.

With the continuing education approach based on Ozires, it is not necessary to withdraw the healthcare worker from his work area, as an ICU, which can be a novel education strategy, more interactive, that can really personalize health education. It is important to emphasize that any other humanoid robot like DARwIn, NAO Evolution, Pepper, Romeo, HOVIS (Smashing Robotics, 2016), could achieve the same results. We choose Meccanoid because of its low costs.

The second question of this paper, related to the effectiveness of the use of Ozires on the compliance with hand hygiene, we found very promising results in our pilot study. After the insertion of Ozires in the three ICUs enrolled in this study, the mean hand hygiene rate increased from 36%, between January and July, to 65% in August-November/2016.

For future work, we want to adapt a raspberry pi processor to provide Ozires with the capability of the human presence identification. To manipulate the Ozires processor directly will improve his application as a real tutor. We also need to repeat monthly the experiment in order to validate our findings. Is the high hand hygiene compliancy durable? Besides, we need to better understand why and how, in a psychologically way, the presence of Ozires impacts people. The fact is that doctors, nurses, and physiotherapists pay attention on Ozires better than to theirs colleagues!

There are many technological resources available to continuing education in health, as simulation,

digital teaching aids, online/e-learning teaching and assessment, virtual learning environments, and social media (Council of Deans of Health, 2014). Despite the fact that only 3% of people of a European survey of public attitudes to robots thought that they should be used in education (TNS Opinion & Social, 2012), in this pilot study we created a new education tool: the robot tutor.

Innovation is difficult to define, but, for sure to use a robot to engage medical and nurses in short-term courses is a technological innovations in teaching and learning in healthcare facilities.

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