

# VaccineHero: A playful XR environment to support toddlers' vaccination

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## ABSTRACT

In the 21st century the value of vaccination in protecting health from infectious diseases is recognized by the entire scientific community. However, there are still people, and especially young children, who remain unvaccinated or experience the vaccination process traumatically, partially due to the fear and anxiety of the impending needle prick. To address this problem, work we develop a playful extended reality technology application named VaccineHero. VaccineHero aims to assist childhood vaccination, limiting or eliminating the negative emotions that children often feel before and after the vaccination process. During the vaccination process, which includes the child, a doctor, and optionally a nurse, the child becomes immersed in the virtual environment, thus avoiding most of the discomfort they would experience in the conventional vaccination procedure.

## KEYWORDS

VR, vaccination, needle fear, toddlers, VaccineHero

## 1 Introduction

Vaccination is one of the most important achievements of the 20th century in the field of public health as it offers the safest and most economical way to protect the population from infectious diseases. The recent epidemic of COVID 19 was a reminder of the role vaccines play in the quality and duration of human life.

However, a percentage of the population, including many children, either systematically avoid vaccination because the fear of the impending needle pick panics them and acts as an inhibitor, or they undergo the process of their vaccination as a traumatic experience.

The VaccineHero project presents an extended reality (XR) application that aims to facilitate the process of childhood vaccination by controlling or eliminating the aforementioned negative feelings of pain and fear. Through the active role taken by the child as the central hero of the story, their attention is completely distracted and drawn into pleasant experiences while at the same time the doctor or nursing staff carry out the necessary vaccination actions to which the child remains unaware. In this

way, the vaccination process is completed without causing negative feelings to the children and the work of the nurses/doctors is facilitated.



Figure 1: VaccineHero's virtual environment

## 2 Theoretical foundations

Virtual reality can be a very effective inoculation tool for pain management and stress reduction. It can help children distract from pain and fear by engaging in other activities, either cognitive or behavioral [1]. Acute pain distraction techniques involve internal (such as imagining) or external stimuli: sound (such as music), visual (such as a book), or audiovisual (such as movies) and require passive engagement (such as watching television, listening to a book) or interactive involvement (interactive, electronic games) or involvement of others (eg, health care providers, parents) [2,3]. It is understandable that interactive engagement, as a more active form, brings about greater absorption in the new occupation. The greater the degree of absorption, the less the sensation of pain [4].

The theory behind VR/XR's role in reducing pain and not just stress is related to the limited attention span that people have. Pain requires attention, and if some of that attention can be diverted (eg, interacting with virtual reality), the patient will have a slower response to incoming pain signals [5]. Virtual reality does not interrupt pain signals, but acts both directly and indirectly on pain perception and signaling through attention, emotion, concentration, memory, and other senses [6]. However, it is important to consider the practicality and accessibility of such technology, as well as to ensure that the content is attractive and age-appropriate.

### 3 Method

VaccineHero is an extended reality (XR) application designed for Android operating systems, utilizing mobile VR technology and Google Cardboard as an affordable alternative. Upon starting the app, toddlers immerse themselves in the 90-second experience, which has been determined to be an adequate duration for medical professionals to administer a vaccination.

We characterize the application as XR, instead of merely VR, because the experience combines the virtual world (the story the toddler is watching in the cardboard) and the physical world (the actions taken by the medical staff on the child's body).

The VR environment presents a short story of a magician lasting approximately 90 seconds. Specific moments in the duration of the story are prearranged to coordinate with the doctor's or nurse's actions during the vaccination process. In the first such moment, the application displays the magician presenting an elixir of power and touching it to the child's arm, who assumes the role of the child protagonist (Figure 2). This corresponds with the medical professional applying cotton to the child's arm. The second such moment involves the magician bestowing magical powers upon the child, which aligns with the administration of the injection.

An external monitor displays a copy of what the child sees, allowing the doctor or nurse to easily recognize the precise moment they need to perform each action, ensuring seamless coordination between the immersive experience and the vaccination procedure.



**Figure 2: Cotton touch**

### 4 Expected results

VaccineHero is an XR application that can be used by doctors and nursing staff, in order to combat or reduce stress and fear experienced by children before and during vaccination and to ensure the smooth progress of its conduct. Also, the use of the VaccineHero application aims to facilitate the work of nurses by reducing the time of vaccination and to the complacency of parents who find that vaccination is no longer a traumatic experience for children. In the long term, the goal of VaccineHero is to help shape a positive perception towards vaccination, to reduce the rate of unvaccinated children and to strengthen public health protection

### 5 Conclusion

In this work we have presented VaccineHero, an XR application that aims to facilitate the vaccination of young children. The platform and system have been fully developed and we are now in the process of planning the first real life applications.

In order to confirm our intended results, the extensive practical application of VaccineHero in health care settings is necessary, with the recording of the results. To assess the efficacy of the approach we plan to use the VACS scale that has been developed for this purpose by another member of our team [7].

Hoping to enhance the vaccination experience of as many children as possible, we aim to make it available, after its suitability has been approved by the competent bodies, to hospitals and vaccination centers. Such a perspective can become possible if it is included in a funding program.

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