Social Robots for Pediatric Asthma Education: A Pilot Study

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Abstract. Hospital discharge marks a crucial transition point in care, particularly for pediatric asthma patients, where education is essential but often rushed or not delivered properly. To address this challenge, we conducted a pilot study to evaluate the feasibility of using a socially assistive robot to deliver asthma education during pediatric hospital discharge. The system integrates validated educational content into a structured, robot-led dialogue. We evaluated the usability, engagement, and perceived effectiveness of the system. The study involved 11 university students assigned roles simulating a discharge scenario. Results showed that over 78% of participants rated the robotâĂŹs usability positively, more than 81% found the interaction engaging, and over 90% expressed a favorable attitude toward the robot. All participants reported satisfaction with the educational experience. These initial findings demonstrate the potential of social robots to enhance discharge education for pediatric asthma, supporting better understanding and preparedness among both patients and caregivers.

Keywords: Human Robot Interaction · Social Robotics · Asthma Education · Robotic Hospital Discharge · Nursing.

1 Introduction

As healthcare systems increasingly integrate digital and automated technologies to improve efficiency and patient outcomes, the role of social robots in clinical environments is gaining traction. In pediatric care, their engaging and socially intelligent behavior can enhance patient interactions. Pediatric asthma management, in particular, benefits from such support, as effective education at discharge is key to improving long-term outcomes.

Pediatric asthma is a leading chronic condition in children and affects approximately 6.3 million children in the U.S. (8.4%), making it the third leading cause of hospitalizations among children under 15 years [5]. Discharge education plays a critical role in aiding families to manage care at home. Unfortunately, traditional methods are often hindered by time constraints, inconsistent delivery, stress, and limited resources [1]. Socially assistive technologies that offer engaging, personalized, and repeatable interactions may help bridge this gap and reinforce key information during this crucial transition, consequently lowering the rate of readmissions. Our study introduces a Human Support Robot (HSR)[3], developed by Toyota, focusing on its role as an educational robot for pediatric asthma patients. Unlike physical support robots that aid with mobility or invasive medical procedures, our robot operates with no direct physical interaction and minimal disruption to clinical workflow. It delivers pre-programmed, evidence-based content tailored for children and their caregivers in a friendly and accessible way.

2 Related Work

Robots have found their place in hospitals over four decades ago, when first robot-assisted surgery was performed by PUMA 560. Now, they are being further integrated into other aspects of healthcare within hospital workflows [6].

Socially assistive robots have demonstrated potential in pediatric healthcare, where engagement, trust-building, and a non-threatening presence are especially important [8]. Studies show they can reduce anxiety, foster positive emotions, and support therapeutic and educational goals in children [11,9]. They proved useful in pediatric oncology [7], and in the preparation of and during medical procedures [2]. Virtual Agents have also been applied to enhance discharge process and planning [10,12]. This trend aligns with the efforts of robot-led education during discharge, a process which is often rushed and inconsistently delivered.

While these innovations demonstrate the value of social robots and AI in hospital settings, most applications during discharge have focused on tasks like documentation, scheduling, or follow-upâĂŤrather than structured, in-person health education. Our pilot study addresses this gap by evaluating the feasibility of a social robot delivering asthma education during the pediatric discharge process.

3 Pilot Study

We conducted a within-subjects pilot study to evaluate the feasibility of using a social robot to deliver pediatric asthma education during the hospital discharge process. The study involved simulated patient-caregiver interactions guided by a robot, incorporating expert-developed educational content (IRB no. 20250406).

3.1 Educational Content and Interaction Design

The educational materials delivered by the robot were developed using a combination of resources from the National Heart, Lung, and Blood Institute (NHLBI), Asthma Academy [4], and insights gathered from in-person visits to an outpatient pediatric pulmonology clinic and expert consultations. The content was

[3] The robot specification can be found here: https://global.toyota/en/detail/8709541.

delivered using a combination of gestures, speech, and videos presented on the robot's screen.

The robot followed a scripted educational sequence designed to simulate the hospital discharge process. The interaction began with the robot receiving patient information - first and last name, date of birth, and prescribed medication/treatment - from a nurse and confirmed its accuracy upon meeting the patient in the treatment room. Once confirmed, the robot introduced itself and explained that it would provide the asthma education.

Fig. 1: Study setup in the SHARE with (from the left) two caregivers and the patient.

The robot-led session included five components: (1) Asthma pathophysiology âĂŞ a video with an expert explanation; (2) Medication overview âĂŞ verbal and visual explanation of medication types; (3) Inhaler use technique âĂŞ video presentation followed by a guided demonstration; (4) Asthma action plan âĂŞ handover of a printed plan with a brief explanation; and (5) Discharge reminders âĂŞ verbal review of next steps. The session took place in the environment shown in Figure 1. The HSR robot is visible in the bottom right corner.

3.2 Study Procedure

The study was conducted over two days at the University of MiamiâĂŹs Simulation Hospital (SHARE) with 11 university students (ages 22âĂŞ49). Participants were randomly assigned to roles: patient, parent, or observer. Sessions were recorded using two cameras to capture video and audio for later analysis.

After informed consent, participants read brief role descriptions and were introduced to the task. Following the interaction, they completed a questionnaire adapted from the Artificial Social Agent (ASA) Questionnaire [3]. The ASA tool developed by Fitrianie et al. is a valid and reliable instrument for evaluating human interaction with artificial social agents ($r = 0.80 - 0.93$ across constructs). The tool comprises 90 items across 19 measurement constructs (in its long version). In this study, we used a subset of items, measuring selected three domains relevant to our study: (AU) *agent usability*, (UE) *user engagement*, and (AT) *attitude toward the agent* as presented in Table 1. An additional item (E1) assessed educational satisfaction. The responses were collected on a 5-point Likert scale, raging from –2 (strongly disagree) to 2 (strongly agree).

Finally, participants were given the opportunity to provide open-ended feedback to share any additional thoughts, suggestions, or reflections on the interaction or the system overall.

Table 1: Average Likert-scale responses for robot-assisted asthma education (N = 11; $\overline{x}$ and σ).

Survey Question	Avg. Response
(AU1) The robot is easy to use.	0.91 (1.14)
(AU2) Learning to work with the robot is easy.	1.27 (0.90)
(AU3) Learning how to communicate with the robot is quick.	1.36 (0.67)
(UE1) I/The user was concentrated during the interaction.	1.00 (0.63)
(UE2) The interaction captured my/user's attention.	1.18 (0.75)
(UE3) I/The user was alert during the interaction.	1.18 (0.98)
(AT1) I see the interaction with the robot as something positive.	1.36 (0.67)
(AT2) I view the interaction as something favorable.	1.36 (0.67)
(AT3) I think negatively of the interaction. (Reversed)	–1.45 (0.69)
(E1) I am satisfied with the educational experience.	1.36 (0.50)

3.3 Study Setup

The study included 11 university students (ages 22âĂŞ49) from the University of Miami, with diverse academic backgrounds in computer science and nursing. n each group, one participant assumed the role of a patient, two acted as caregivers, and the remaining observed the interaction[4]. Most reported limited experience with robotics, though many had regular exposure to computers or AI tools.

3.4 Results

As shown in Table 1 and Figure 2, participants rated the robot highly on usability. Mean scores were 0.91 for âĂIJThe robot is easy to useâĂİ (AU1), 1.27 for âĂIJLearning to work with the robot is easyâĂİ (AU2), and 1.36 for âĂIJLearning how to communicate with the robot is quickâĂİ (AU3). On average, 78% of participants responded positively (1 or 2 on the scale), indicating strong ease of useâĂŤeven among those with limited prior exposure to robotics.

User engagement scores were similarly high, with average ratings of 1.00 (UE1: âĂIJI was concentratedâĂİ), 1.18 (UE2: âĂIJThe interaction captured my attentionâĂİ), and 1.18 (UE3: âĂIJI was alertâĂİ). On average, 81.8% of participants reported being positively engaged in the interaction. Participants who rated the robot highly on usability also tended to report strong engagement, suggesting that intuitive interfaces may directly support attention and immersion.

Attitudes toward the robot were overwhelmingly favorable. AT1 (âĂIJI see the interaction as something positiveâĂİ) and AT2 (âĂIJI view the interaction as something favorableâĂİ) both averaged 1.36, while AT3 (âĂIJI think negatively

[4] Study video: https://www.cs.miami.edu/~visser/hsr-videos/share-2025.mp4

of the interactionâĂİ) was strongly disagreed with (M = –1.45). Over 90% of participants expressed a positive attitude across these items.

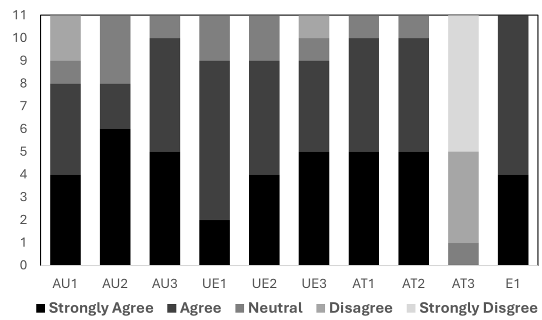

Fig. 2: Study questionnaire questions.

Participants also endorsed the robotâĂŹs educational value, with a mean score of 1.36 (SD = 0.50) and 100% of responses in the positive range.

Importantly, no statistically significant relationships were found between participantsâĂŹ age, race, or familiarity with computers, as well as the role assigned role (caregiver, patient, observer) and their reported usability, engagement, attitude toward the robot, or perception of the educational value. This suggests the systemâĂŹs accessibility and effectiveness were consistent across diverse backgrounds and levels of technical experience. A significance threshold of $p < 0.05$ was adopted for all tests evaluating associations between demographic characteristics and participant responses.

Open-ended responses emphasized the robotâĂŹs strengths, including its âĂIJsoothing voiceâĂİ and clear explanations. The synchronized breathing demonstration was described as calming and effective for illustrating inhaler technique. Participants appreciated the instructional videos but noted that the screen was small and lacked variety. Suggestions included adding more visuals and integrating video alongside speech to increase engagement. Additionally, a suggestion was made to include interactive questions during the session to enhance attention and assess real-time understandingâĂŤan idea that aligns with active learning principles in health education.

4 Discussion and Future Work

These findings provide strong early support for the use of a social robot in pediatric asthma education. The robot was found to be easy to use, engaging, and positively received by participants, despite most having little to no prior experience with robotic systems. High usability and engagement scores suggest the system works well for first-time users with minimal instruction, even in emotionally charged hospital settings. Over 90% reported positive attitudes, and all participants were satisfied with the robot-led education, indicating strong potential for scalable, repeatable discharge interventions.

While encouraging, these findings are preliminary. The use of simulated roles and a homogenous participant group (university students) limits generalizability. Future studies should include actual patients and caregivers, explore correlations between prior technology experience and interaction outcomes, and evaluate long-term effects on knowledge retention and adherence.

Follow-up studies are currently being planned to implement the system in real pediatric settings and assess longitudinal outcomes such as asthma control and caregiver confidence post-discharge. Future studies should include comparative evaluations between robot-led and nurse-led discharge education to assess relative effectiveness in knowledge retention and behavior change. Additional goals include expanding interactivity, adding multilingual content and visual aids, and analyzing recordings to create a labeled HRI dataset.

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