

Implementing *Triage-Bot*: Supporting the Current Practice for Triage Nurses

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Introduction

- Healthcare workers (HCWs) are critical in the delivery of efficient & effective emergency care
- Current Canadian Emergency Department (ED) Challenges:
 - Staff shortages*; it is expected that there will be a shortage of 100,000 nurses in Canada by 2030
 - Lack of Primary Care*: 6.5 million Canadians do not have a family doctor, leading to strain of ED resources
- Increased pressure in both time & volume of patients results in a greater triage & medication error rate, endangering the patient and leading to preventable exacerbations of patient conditions and eroding trust in the healthcare system.
- Technology that incorporates innovative analytical methods, automation of routine, and efficient processing can be leveraged to streamline clinical processes and improve the overall quality and efficiency of healthcare delivery.

Objectives:

- Develop a real-time voice and video communication system for a medical triage service that will allow patients to report their health concerns and/or conditions
- Develop a means of patient authentication and secure data transfer, storage, and linking data with patients' electronic medical records (EMR)
- Use non-invasive methods to measure patients' biometric data and emotions, such as face video-based remote photoplethysmography and off-the-shelf sensors and verify detected emotions with the patient using prompts
- Categorize and rank patients for triage service based on the generated reports and EMR risk profiles
- Assess effectiveness and usability through feedback from patients and healthcare providers.

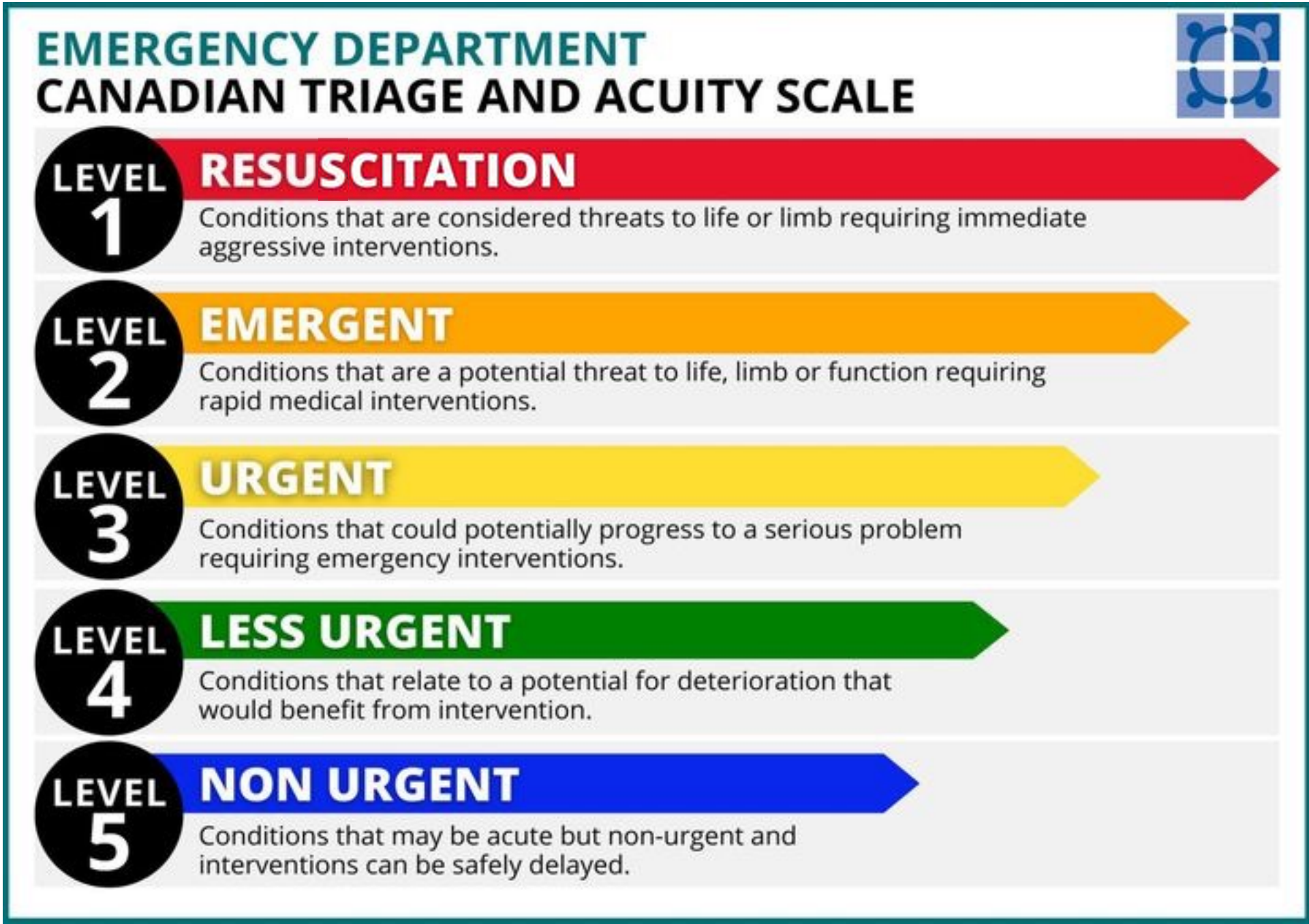


Figure 1. Canadian Triage Acuity Scale (CTAS).
From Campbellford Memorial Hospital.

Triage-Bot is an AI conversation robot that is intended to become an online software service to complement existing patient triage systems within Emergency Departments.

Triage-Bot: An Overview

Key Features

- Authentication:** Identity verification of patients & caregivers via password & facial recognition
- Patient Ranking:** Based on CTAS scale, to assign priority & automated notifications to health clinic(s) or emergency services to support critical/high-risk patients
- Report Health Issues:** Questions (pre-set & open-ended) are asked via voice & video for patient-led description
- Secure Data Transmission and Storage:** Triage-Bot transmits & processes encrypted data to secure server.
- rPPG-Based Vital Sign Measurement:** Automatically measures heart rate (HR), heart rate variability (HRV), oxygen saturation (SpO2), respiratory rate (RR), blood pressure (BP), blood glucose (BG) and stress.
- Emotion Recognition:** Identify seven distinct emotional states through AI-powered facial expression: calm, happy, sad, angry, fearful, surprised, and disgusted.
- Audio Transcription:** Voice data collected through the Triage-Bot is converted to text for analysis.
- Privacy and Data Security:** Data collected from rPPG, emotion, and voice communication are used to create a summary of the patient's health condition that can be used by medical professionals to provide medical advice

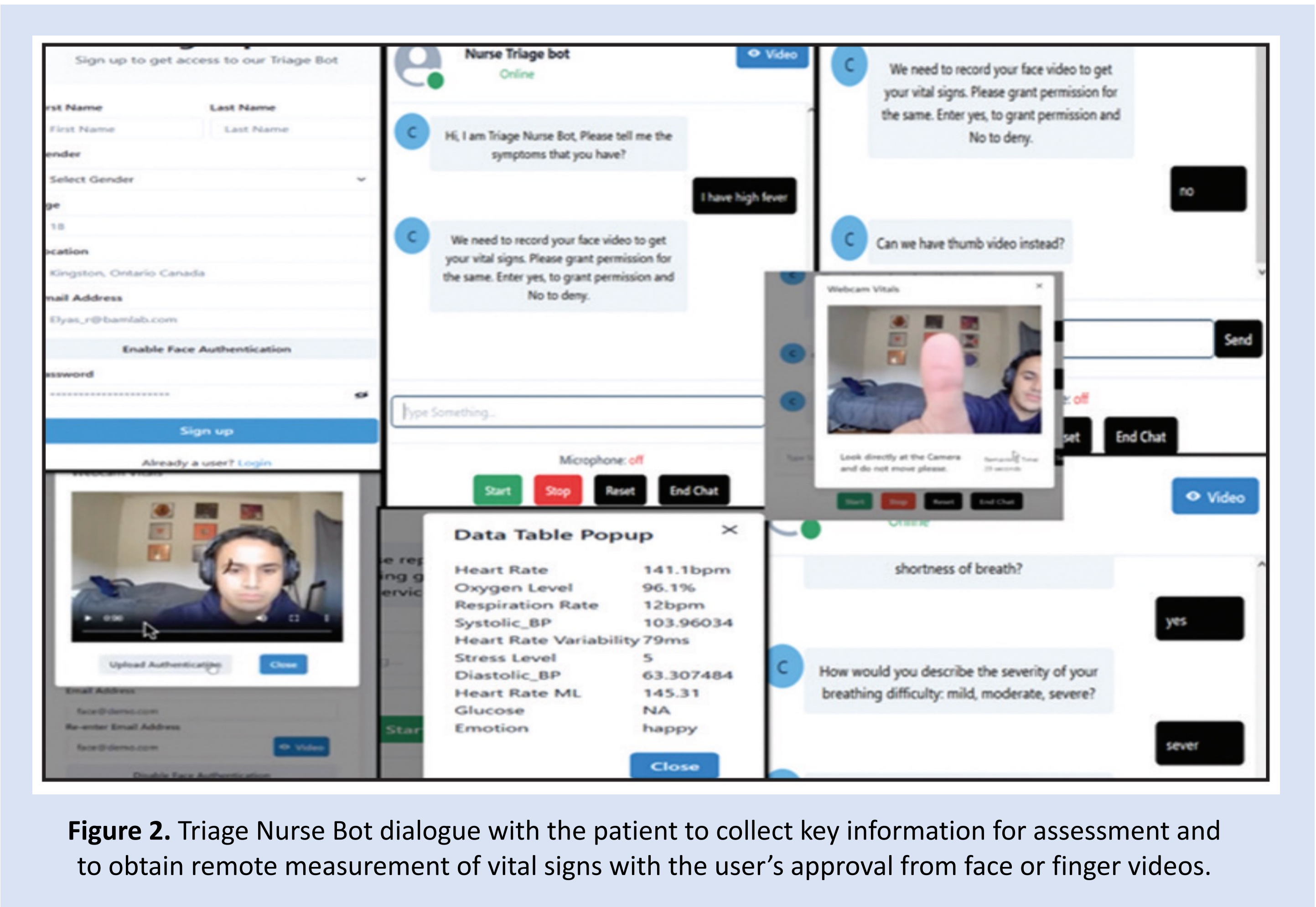


Figure 2. Triage Nurse Bot dialogue with the patient to collect key information for assessment and to obtain remote measurement of vital signs with the user's approval from face or finger videos.

Implementation

- Within ED waiting rooms, Triage-Bot can be utilized to **add information to health records** to support nursing assessment of patient CTAS scores, promoting consistency & fairness and reducing nurses' workload to streamline the process of getting patients seen & treated
- Outside EDs, conversational agents within an AI system can reduce nurses' workload by **completing administrative tasks and patient follow-up**; AI (such as Triage-Bot) can be a valuable tool to make patient care more efficient and effective by providing personalized instructions, remotely monitoring patients, or supporting possible diagnoses, thereby accelerating the healthcare process.

Future Directions & Limitations

- Future Directions:**
 - Improve accessibility & equity for Triage-Bot on a continuous basis—user preferences have been considered with the inclusion of voice and/or text interaction based on user options and to provide better accessibility, but further implementation to serve a wider range of patients is to be implemented.
 - Goal: reduce nurses' workload & complement current practices in triage to reduce preventable errors.**
- Limitations:**
 - Ethical Considerations:** general concern that Generative AI models lack transparency and explainability due to their opaque use of big-data resources and analytics, and the complex implementation of algorithms without explainable functionalities; However, Triage-Bot uses only rule-based dialogues to avoid this issue.
 - Critical engagement with patient**—relies on nurse guidance or education related to when to visit an ED to balance over- or under-estimation of needs to self-diagnose
 - Not a replacement for healthcare workers**—challenging to capture expert knowledge in an AI system. Conversely, it complements existing practices for patient triage.
 - Voice and text interaction can be influenced by user's & AI's understanding of language, culture, and age-related factors
 - Automation bias:** human deference to automated decisions is a concern.