

PURP-LE Pressure Ulcer Risk Prevention Wearable

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BACKGROUND

- A pressure ulcer is an area of localized damage to the skin and the underlying tissue which is caused by many factors including pressure, shear, friction, or a combination of these [1]
- Pressure ulcers are a prevalent problem in Canadian hospitals occurring at rates ranging from 15.1%-29.9% depending on the care setting [1]
- Current compliance of standard patient-turning protocols is around 60% [2]

OBJECTIVES

To design a wearable shirt that:

- Reduces risk of developing hospital-acquired pressure ulcers in immobile patients
- Increases patient-turning compliance in hospitals

DESIGN

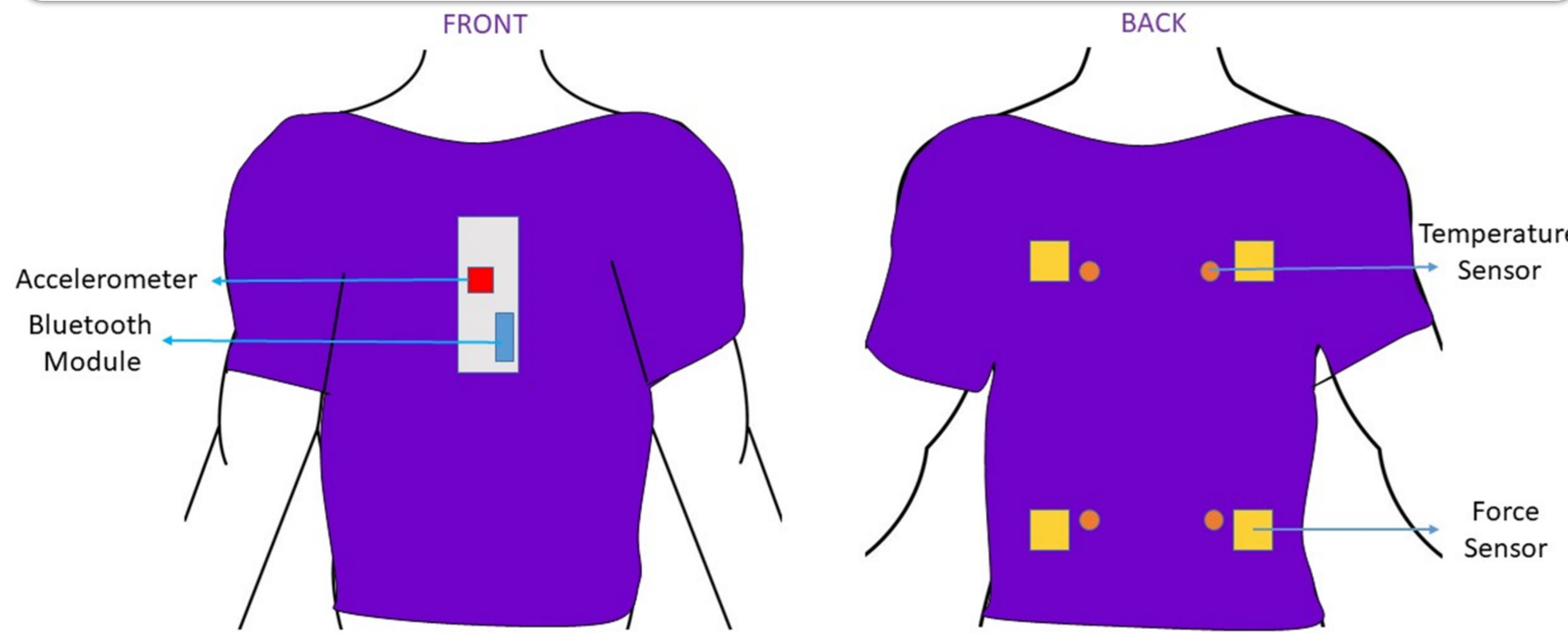
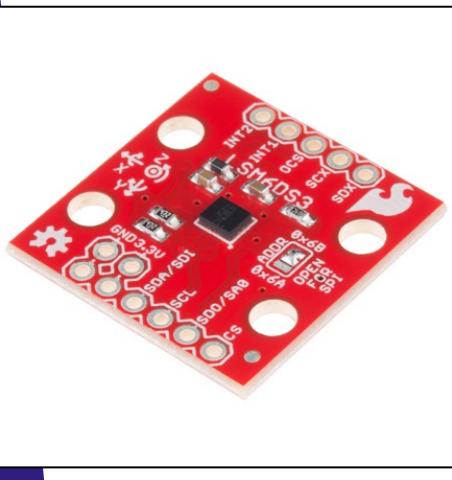


Figure 1: Component layout of device (force and temperature sensors are inside shirt)

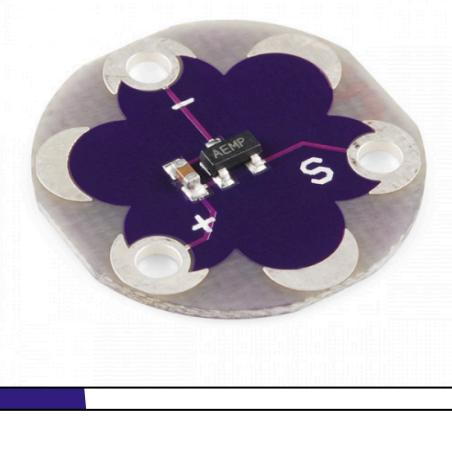
- Four force sensors and temperature sensors are placed on and near high-risk areas on the back (shoulder blades and hips)
- An IMU is placed on the chest to determine the patient's position
- All data is collected and processed by a Teensy 3.5 microcontroller, and relayed to mobile app by a Bluetooth module
- All components are connected with conductive thread

DESIGN COMPONENTS



LSM6DS3 – Accelerometer/Gyroscope

- Placed on patient's chest, reads acceleration data and converts to angle to determine patient's position



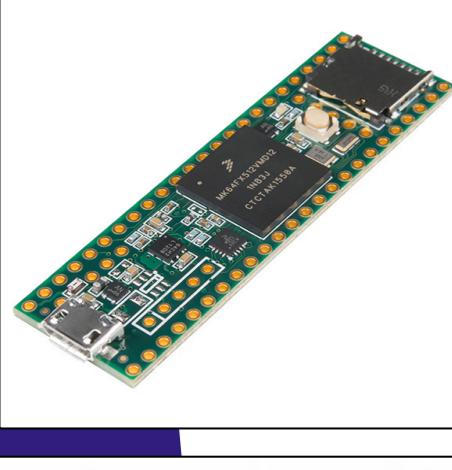
DEV-08777 – LilyPad Temperature Sensor

- Placed near high-risk areas, sense skin temperature which may be a factor in ulcer development [2]



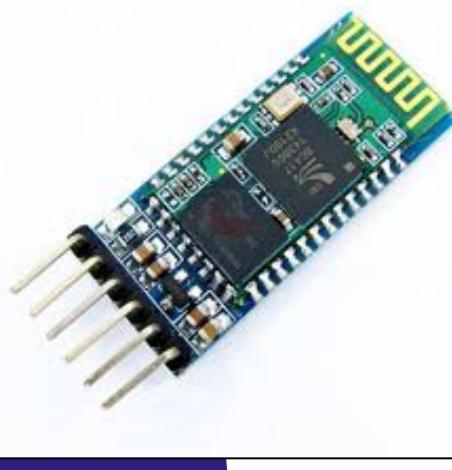
FSR01CE – Force Resisting Sensor

- Placed on the high-risk areas, sense prolonged pressure above a threshold and act as switches to turn off/on the alarm



Teensy 3.5 – Microcontroller

- Programmed to control all other device components and allow for the gathering and processing of data



HC-05 – Bluetooth Module

- Conveys data collected from sensors to a mobile application via Bluetooth

EXPECTED OUTCOMES

- Increased automation of the standard patient-turning protocol in hospitals
- Wireless implementation onto a single device to streamline patient care

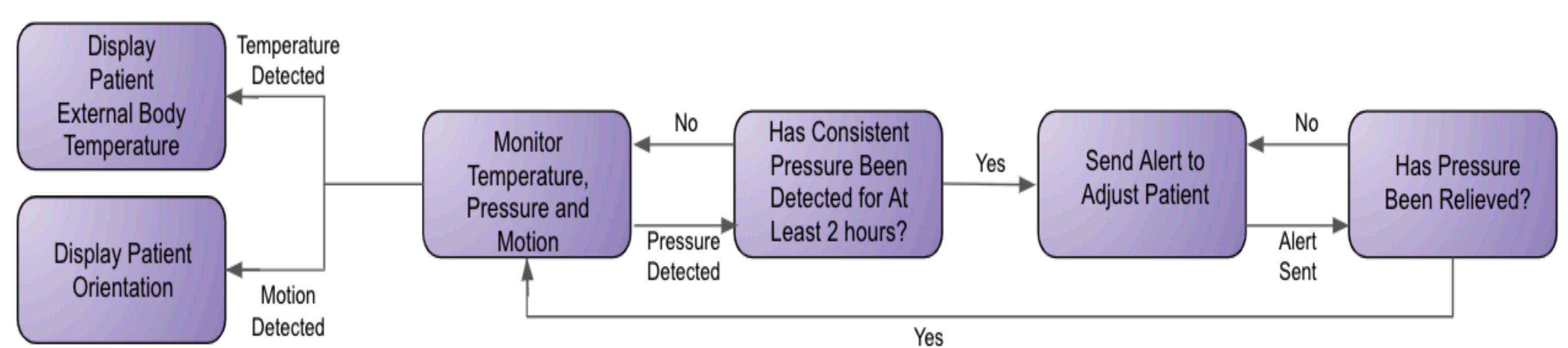


Figure 2: System output realization

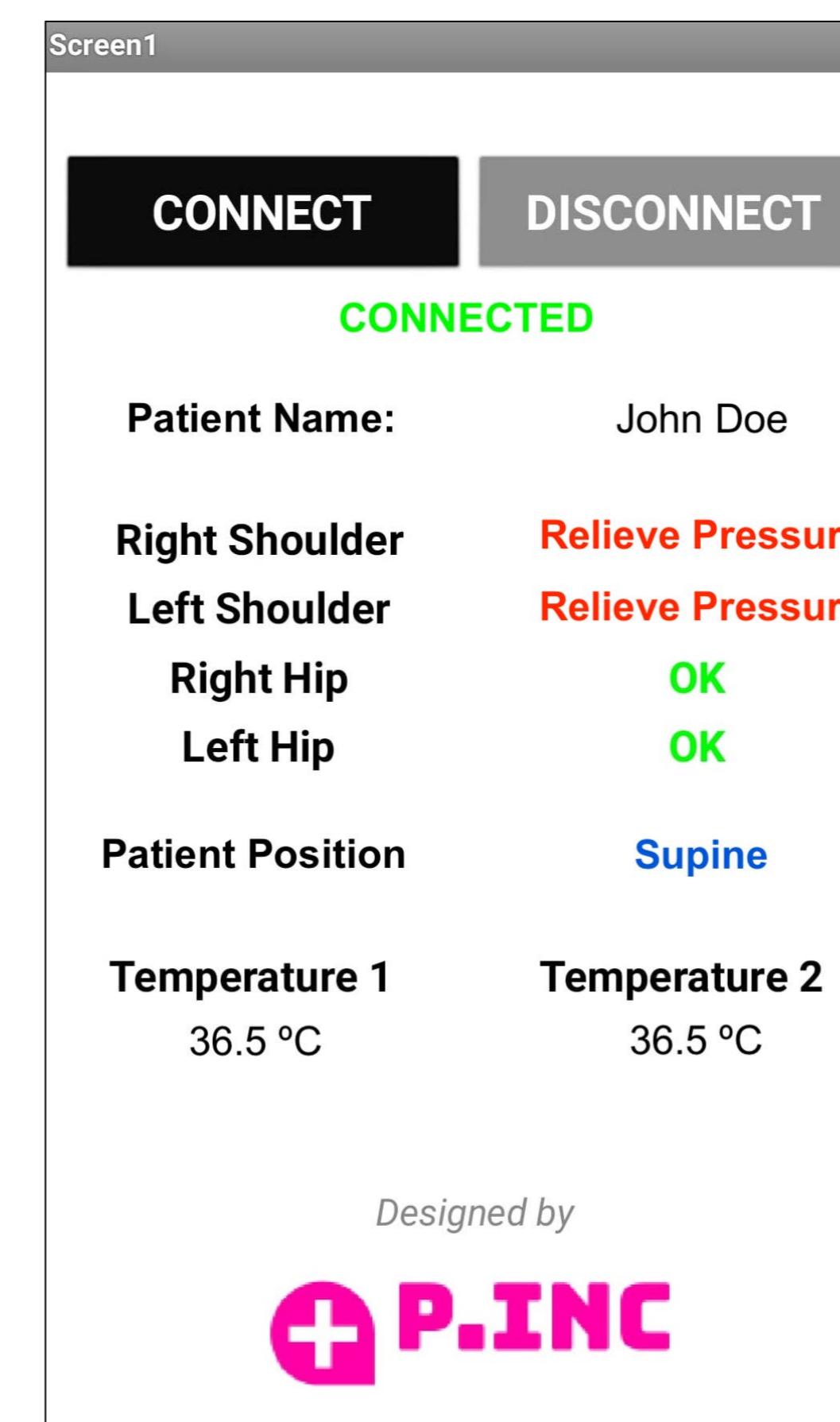


Figure 3: App user interface

Mobile app features:

- Data is communicated via Bluetooth
- Notifies caregiver which high-risk areas are experiencing pressure within accepted time (OK)
- Alerts caregiver which area has experienced prolonged pressure (Relieve Pressure)
- Presents patient's real time position
- Presents patient's real time skin temperature near high-risk areas

MARKET ANALYSIS

- Pressure ulcer incidences cost hospitals approximately \$11 billion USD annually in the US alone [1]
- The estimated cost of individual patient care is between \$20,900 and \$151,700 per ulcer [3]
- The initial prototype cost was approximately \$141 CAD
- A patient could potentially save between \$20,759 and \$151,559 if a pressure ulcer was prevented by using PURP-LE

FUTURE WORK

- Future work will look at powering the device using a battery
- Incorporating more sensors to cover more high-risk areas
- Using sensor data to detect early development of ulcers
- Making entire device washable and more comfortable for greater longevity of device

References

- [1] Ackroyd-Stolarz, Stacy. "Improving the prevention of pressure ulcers as a way to reduce health care expenditures." Canadian Medical Association Journal 186.10 (2014): E370-E371.
- [2] Pickham, David, et al. "Evaluating optimal patient-turning procedures for reducing hospital-acquired pressure ulcers (LS-HAPU): study protocol for a randomized controlled trial." Trials (2016): 190.
- [3] Agency for Healthcare Research and Quality. Preventing Pressure Ulcers in Hospitals. October 2014. 11 October 2019. <<https://www.ahrq.gov/patient-safety/settings/hospital/resource/pressureulcer/tool/pu1.html>>.

