MED AI JAM - GROUP 2

VAITALS

Med x Tech

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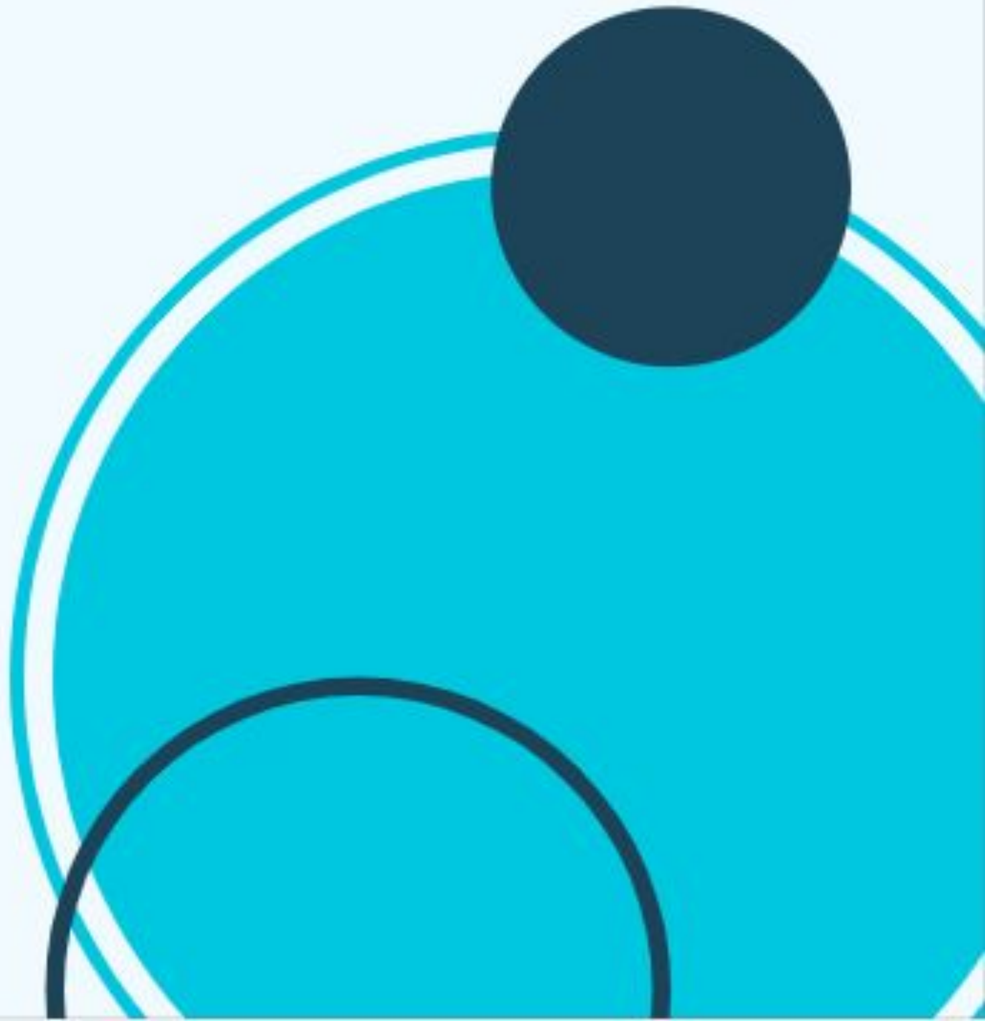


67 YEAR OLD MALE STATUS POST HIGH SPEED MOTOR VEHICLE COLLISION. ON EXAM, PATIENT WITH BRUISES TO THE FOREHEAD, PUPILS ARE EQUAL AND REACTIVE TO LIGHT. NEUROSURGERY HAS BEEN CONSULTED.

BLOOD PRESSURE: 149/89
HEART RATE: 73
RESPIRATIONS: 18

THE WORST OUTCOME: HERNIATION

- Occurs due to high pressures in the skull (blood)
- Herniation of the brain has very poor outcomes (1)
- Interventions include: Medications (Mannitol, Saline) and/or surgery (Craniotomy/Burr hole) to reduce the pressure

CLINICAL SIGNS (Physical Exam)

- Early: Headaches, somnolent.
- Late: Obtunded, non-responsive, unilateral dilated pupils, papilledema.

VITAL SIGNS (HR/BP/RR/O2 Sat)

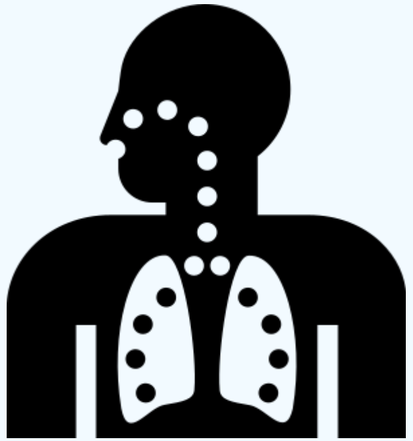
- Cushing's Reflex

1. Decker, R. & Pearson-Shaver, A. L. Uncal Herniation. in *StatPearls* (StatPearls Publishing, 2018).

CUSHING'S REFLEX

Tachycardia -> Bradycardia

Hypertension

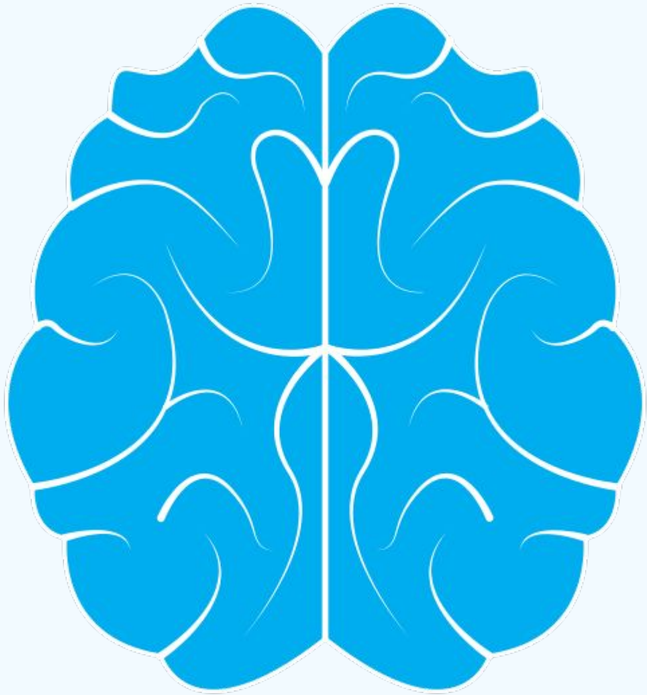


Irregular Respirations

1. Fodstad, H., Kelly, P. J. & Buchfelder, M. History of the cushing reflex. *Neurosurgery* **59**, 1132–1137; discussion 1137 (2006).
2. Kalmar, A. F., Van Aken, J., Caemaert, J., Mortier, E. P. & Struys, M. M. R. F. Value of Cushing reflex as warning sign for brain ischaemia during neuroendoscopy. *Br J Anaesth* **94**, 791–799 (2005).

THE GOLD STANDARD:

Head CT Scans



AI TO DETECT CUSHING'S REFLEX (1)

- Change in HR >20%
- Change in BP (MAPS) >20%
- Irregular Respirations (Apnea > 5 seconds or respiratory rate >20 bpm)

AI TO DETECT HEMORRHAGE ON CT (2)

- Demonstrated by Chang et al
- Able to detect hemorrhage
  - Sensitivity: 95%
  - Specificity: 97%

1. Yumoto, T. *et al.* Impact of Cushing's sign in the prehospital setting on predicting the need for immediate neurosurgical intervention in trauma patients: a nationwide retrospective observational study. *Scand J Trauma Resusc Emerg Med* **24**, 147 (2016).
2. P.D. Chang, E. Kuoy, J. Grinband, B.D. Weinberg, M. Thompson, R. Homo, J. Chen, H. Abcede, M.Shafie, L. Sugrue, C.G. Filippi, M.-Y. Su, W. Yu, C. Hess, D. Chow Hybrid 3D/2D Convolutional Neural Network for Hemorrhage Evaluation on Head CT. American Journal of Neuroradiology Jul 2018, **DOI:** 10.3174/ajnr.A5742

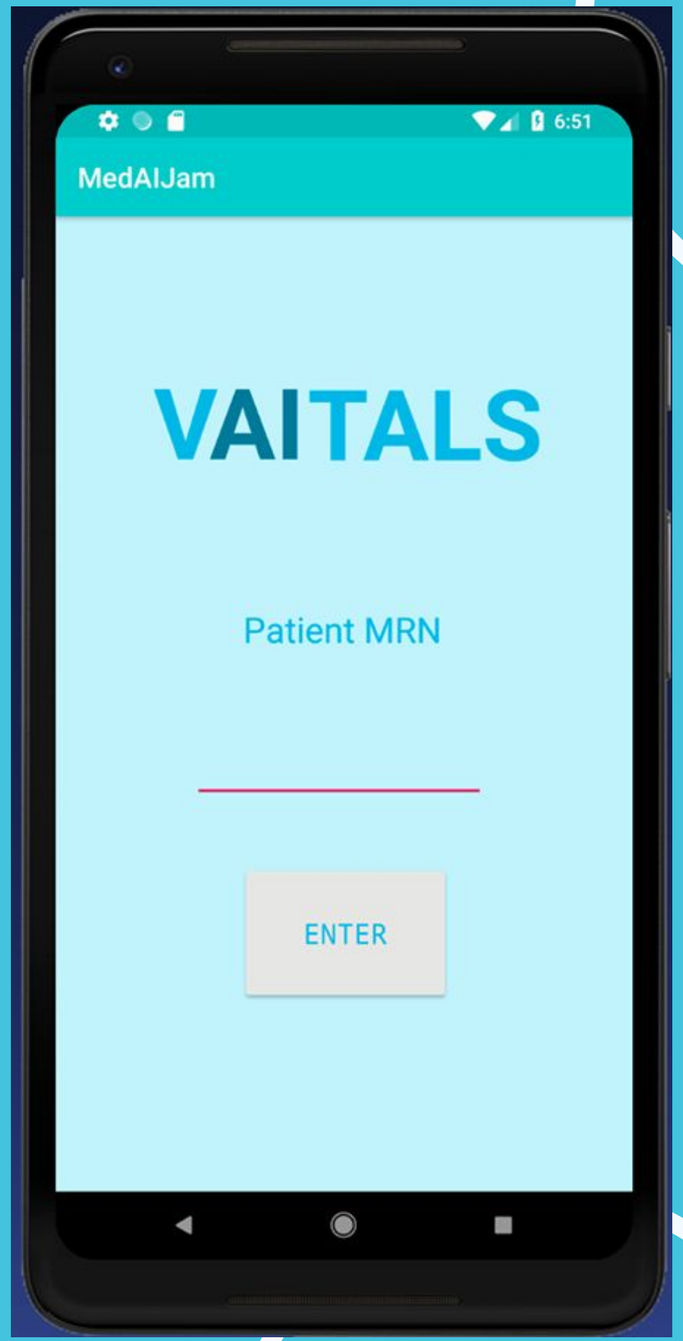
TECHNICAL SOLUTION

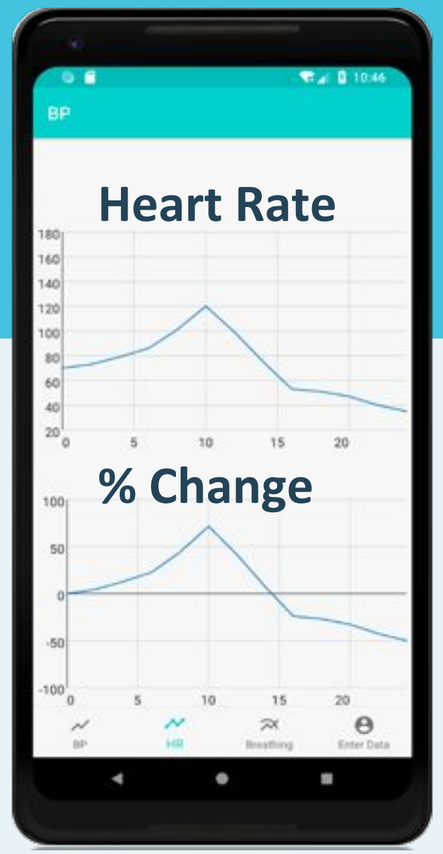
AI training

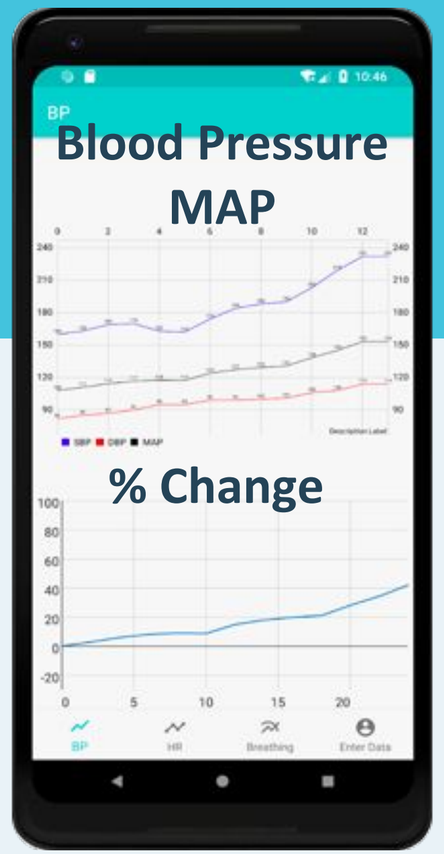
- SKLearn Library, Random Forest Classifier

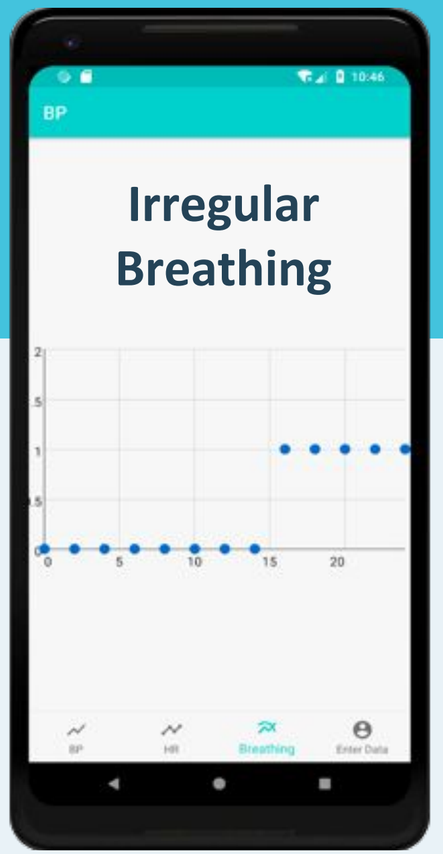
Mobile app programming

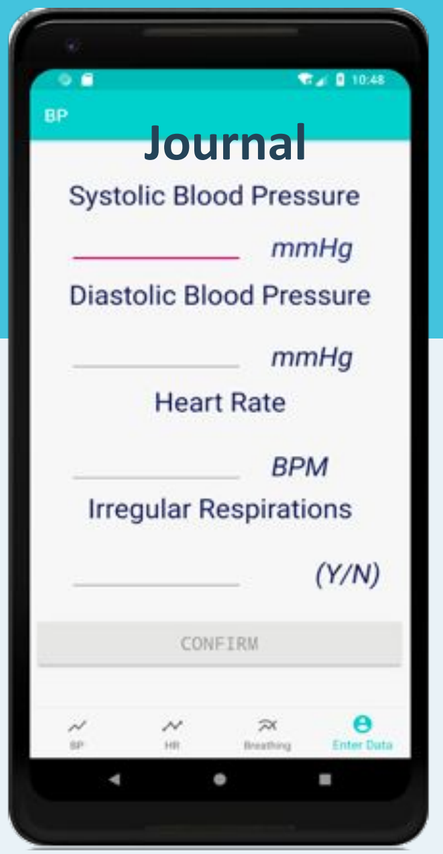
- SKLearn Porter imported into Android Studio



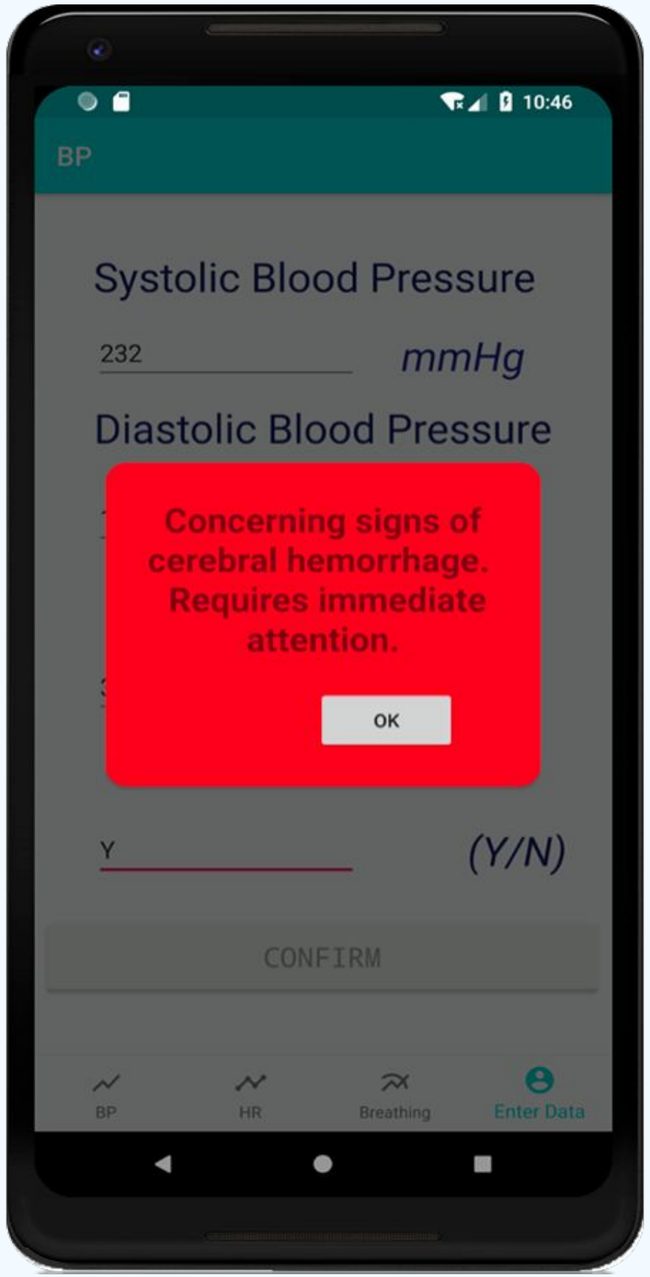

BP
Heart Rate
% Change
BP
HR
Breathing
Enter Data


BP
Blood Pressure MAP
% Change
BP
HR
Breathing
Enter Data


BP
Irregular Breathing
BP
HR
Breathing
Enter Data


BP
Journal
Systolic Blood Pressure
mmHg
Diastolic Blood Pressure
mmHg
Heart Rate
BPM
Irregular Respirations
(Y/N)
CONFIRM
BP
HR
Breathing
Enter Data

EARLY ALERT SYSTEM



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BLOOD PRESSURE: 149/89 -> 203/104
HEART RATE: 73 -> 39
RESPIRATIONS: 18 -> Irregular pattern

Without AI

- Patient develops late clinical signs of herniation: unilateral fixed and dilated pupil, papilledema, posturing.
- Burr hole evacuation is attempted, but patient never regains consciousness.

With AI

- Clinicians alerted to early vital sign changes
- Patient is re-evaluated, medical interventions are made to prevent increased intracranial hypertension
- Patient regains consciousness after recovery from neurosurgery.

THE VISION

AI FOR VAITAL SIGN MONITORING

- Cushing's Reflex is well described in the literature, but is there more?
- Discover new subtle vital sign changes to predict a decompensating patient sooner.
- Provide a realistic means of monitoring these subtle changes: offload work from nurses/physicians, earlier and more sensitive detection rates, and improved patient outcomes.