

Background

- Healthcare workers in the critical care unit (CCU) are constantly put into intense situations, making approximately 100 urgent clinical decisions over the course of a shift.
- Constantly being in such a stressful environment leaves CCU staff feeling mentally fatigued, stressed, and overloaded.
 - This in turn often results in a substandard quality of healthcare administered, such as making poor clinical decisions and practicing defensive medicine.
- In healthcare, the practice of defensive medicine is defined as the administration of unnecessary tests and procedures to decrease the probability of being involved in a medical malpractice suit.
 - E.g., A healthcare worker in the CCU repleting a patient's electrolytes even though they are within the normal range.
- Defensive medicine unnecessarily wastes a tremendous amount of money.
 - Regarding electrolyte depletion alone, minimizing practices of defensive medicine would amount to saving approximately \$1.25 million per year.
- However, implementing Clinical-Decision Support Systems (CDSS) can be a very effective way to minimize these unnecessary costs.
- CDSS are computer-driven programs that process electronic health records (EHR) and provide healthcare personnel with evidence-based guidance outlining how to approach patient care.
 - The instructions provided by CDSS are specific to each individual patient.
 - Ultimately, CDSS are tools intended to aid in providing the most effective healthcare to patients.
 - In the context of this project, CDSS would be able to help staff make decisions regarding when to replete electrolytes

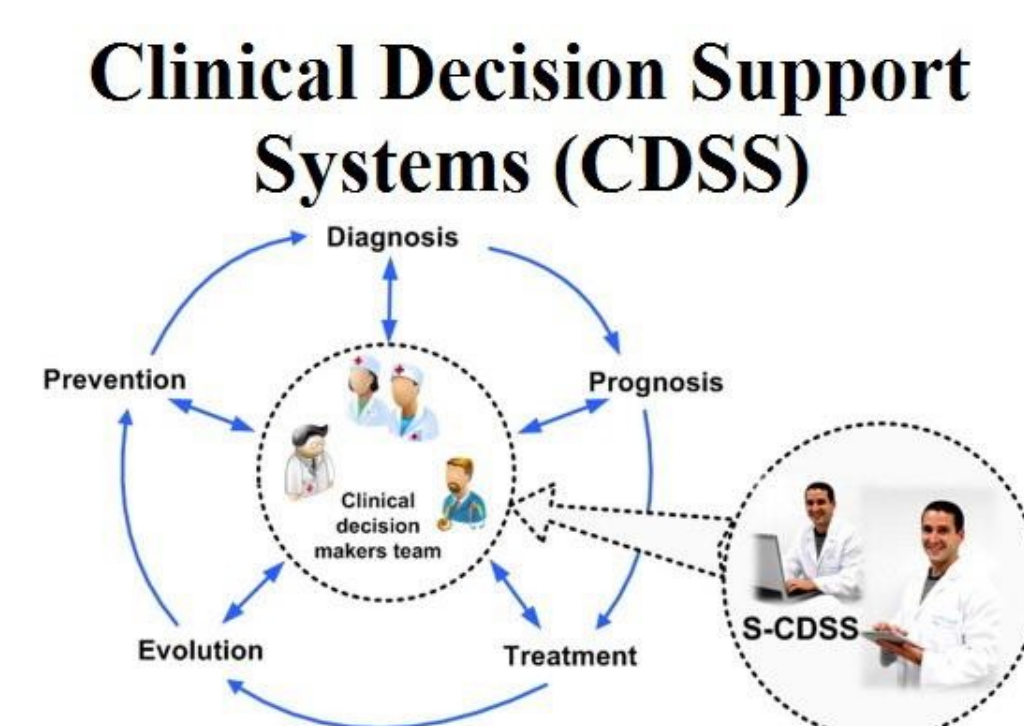


Figure 1. This diagram provides a graphic representation of CDSS and what their function is.

- There are two barriers that exist for us to effectively implement CDSS into the decision-making of CCU personnel:
 - Many people who work in healthcare are understandably somewhat resistant to having a computer program making suggestions and telling them how to do their job.
 - It is important to have some way of gauging or quantifying the mental load that a given staff member experiences over the course of a shift (and at what points in the shift are they more/less stressed.)
- To address these issues, we designed a REDCap survey that covers the following different areas:
 - Demographic data
 - Electrolyte repletion data
 - Clinical scenarios
 - Psychological data collection, including:
 - NASA-TLX (Task Load Index)
 - STAI (State-Trait Anxiety Inventory)
 - IUS-12 (Intolerance of Uncertainty Scale – Short Form 12)
 - CDSS experience and thoughts questionnaire
 - AI comparison questionnaire
 - Given some sample data, the participant is asked to provide when along a timeline they would replete electrolytes, and their responses are compared to that which was determined by an AI program

Figure 2. This is the NASA-TLX survey that we incorporated into our REDCap survey that prompts the participant to assign one of 21 gradations to a certain type of load (ranging from “very low” to “very high.”)

My Experience and Role In the Project

My Role:

- One component of the research that I did over the summer involved learning some fundamentals about deep learning and artificial intelligence.
 - I spent a lot of time (particularly in the beginning of the program) reading Richard S. Sutton’s and Andrew G. Barto’s *Reinforcement Learning: An Introduction* to learn about some basic principles of machine learning.
 - I also got some exposure to coding in Python, specifically involving processes that are related to machine learning.
- Another major component of the research I did this summer consisted of me designing and creating the REDCap survey that we are using to obtain information from healthcare personnel regarding their experience/comfortability with CDSS as well as the mental/psychological burden that deal with on shift.

My Overall Experience:

- Something about Dr. Laudanski’s project that interested me so much is that I recently changed my intended direction in life from going to medical school and becoming a doctor to wanting to work in the areas of machine learning and artificial intelligence (AI).
 - That said, I am still open to the idea of doing work in a medical/healthcare context; I just know that I no longer want to get pursue an MD.
- Given this, Dr. Laudanski’s project was perfect in that I got some experience in learning about AI as well as what sorts of things I will theoretically work on if I choose to work in the context of healthcare.
 - From working with Dr. Laudanski, I feel much more confident that studying AI is the right path for me (and that I am still open to working in a healthcare setting).

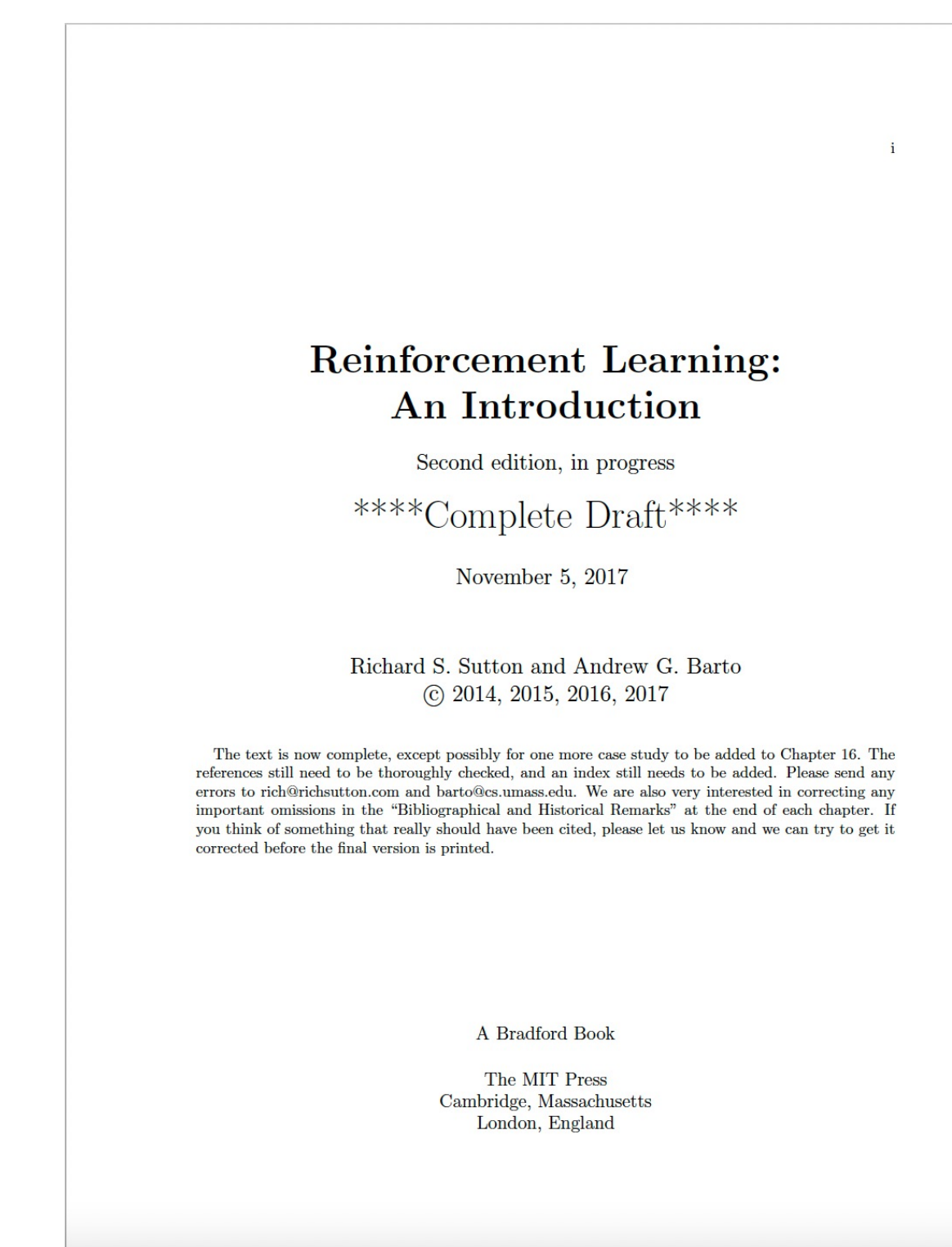


Figure 3. This diagram provides a graphic representation of CDSS and what their function is.

Project Objectives/Goals

- Fundamental Question:** How willing are healthcare personnel in the CCU to allow CDSS to become an integral part of the clinical decision-making process?”
- Primary objectives:**
 - To recognize the significant factors that contribute to medical decision-making in the CCU.
 - E.g., why someone would replete a patient’s K+ when they do.
 - To evaluate the current healthcare environment and determine how we can implement advanced CDSS (and whether or not it would even be possible at this point), and if not, to identify what issues need to be addressed for this to happen.
- The following are some examples of factors/issues that need to be taken into account:
 - We seek to have a better understanding of when CDSS assistance would be most helpful/necessary, taking into account the urgency of the decision, the mental load that the healthcare provider is experiencing, etc.
 - It is important to understand how comfortable/experienced healthcare providers are with CDSS assistance, to what extent they would be willing to have this assistance, and anything that can be done to make the transition more frictionless.

Current Stage of the Project

- Currently, the project is in the stage of IRB submission
- After approval, we will be able to proceed with administering the surveys to healthcare staff and start to process the data that we receive regarding the psychological/stress-related loads they experience as well as their comfortability with integrating CDSS into their clinical decision-making.

References

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