

**PROPOSAL TITLE:** Accurate Blood Loss Estimator (ABLE)

**PROJECT LEAD(S):** Alexander Lin MD, MBA, FACS

**EXECUTIVE SPONSOR(S):** Maimuna Sayyeda

**ABSTRACT:**

Banked blood is one of our most precious resources. Our medical device prototype ABLE, Accurate Blood Loss Estimator, utilizes wireless technology and advanced algorithms to make accurate intraoperative blood loss estimates, which can minimize unnecessary over-transfusion which results in both cost and commodity-savings. By making accurate quantitative estimates of intraoperative blood loss, ABLE also helps with standardization of surgeries and perioperative blood loss average expectations, which further helps predict blood bank needs and further conserves blood resources.

**TEAM:**

- Alexander Lin, Professor and Director of Surgical Innovations, UCSF Plastic Surgery
- Prachi Shinglot, Research Coordinator, BCH Oakland, Department of Surgery
- Priya Ramaswamy, Assistant Professor, Anesthesiology, UCSF

**PROBLEM:**

Despite the continued advancement of healthcare technologies, blood loss remains a leading cause of operating room (OR) deaths worldwide. Unlike vital signs, blood loss is not monitored automatically and continuously, which is akin to flying a plane with no fuel gauge. Currently, the standard of care to estimating blood loss is by visually estimating the surgical field, which studies have proven highly inaccurate. To compensate, surgical teams often over-transfuse blood during surgery, which leads to significant patient risk and wasted resources, estimated at \$10-20billion in the US annually (Smith et al, 2020) This yields a potential savings opportunity of greater than \$1 million per hospital per year. A better solution to accurately estimate surgical blood loss is needed. OR Operating experiences and published studies continue to heighten recognition of *significant economic benefit* to improved accuracy and decision making, leading to *improved patient outcomes, cost savings* for hospitals and ambulatory surgery centers.

**TARGET:**

Specific: Develop and implement the Accurate Blood Loss Estimation (ABLE) prototype for testing its ease of use and accuracy of recorded data in operating rooms (ORs), and ability to affect future transfusion decisions.

Measurable: Measure ABLE's Accurate Blood Loss estimates during surgeries and compare to intraoperative transfusion decisions. Achievable: Caring Wisely grant to help with personnel to achieve the logistics required for this project.

**Relevant:** Address the critical need to improve blood loss estimation methodologies in ORs, as inaccurate estimations lead to complications and unnecessary costs within healthcare systems.

**Timebound:** Complete testing of the ABLE prototype in ORs to gather essential data on its technical accuracy and usability, according to quarter-by-quarter goals

**Inclusive:** Involve surgical teams, anesthesiologists, operating room nurses, and hospital administrators in the testing process to gather diverse perspectives and ensure the prototype meets their needs.

**Equitable:** Ensure equal access to ABLE for all types of procedures and multiple types of patients (pediatric, adults) and multiple operating room types.

**Qualitative:**

**Improved patient safety:** Early recognition of accumulating blood loss during medical procedures can reduce adverse patient events such as death, ICU admission, and myocardial infarction, leading to improved patient outcomes and overall safety.

**Enhanced decision-making:** Accurate blood loss estimation provided by ABLE can prevent unnecessary blood transfusions by addressing the overestimation of blood loss amounts, thereby facilitating better decision-making by surgical teams.

**Streamlined workflows:** Implementation of ABLE in ORs can optimize resource utilization and foster continuous improvement in surgical practices, leading to streamlined workflows and improved efficiency.

**Quantitative:**

**Cost savings:** Preventing unnecessary blood transfusions through accurate blood loss estimation can reduce the financial burden associated with blood management for hospitals, potentially yielding substantial cost savings.

## **GAPS:**

Blood loss remains a leading cause of OR deaths worldwide. Currently, standard care is estimating blood loss during surgery by visually estimating the surgical field, which medical studies have proven highly inaccurate. A study in *Surgery* shows that visual blood loss estimation even for experienced surgeons, anesthesiologists, and operating room nurses, ranges from inaccuracy rates over 52% to 85%. Other studies have shown that OR personnel using visual estimation of blood loss miscalculated the amount of blood by a median value of 30% regardless of profession, years of experience, and self-assessed visual estimation ability. (Kollberg et al., 2019) Traditional methods of weighing “sponges” (washcloths used to keep the surgical field clean during surgery) to determine blood amounts are time-consuming, disturb the workflows of the operating room, prevent OR nurses from performing other vital functions, and remain prone to human error. This leads to the conclusion that they “may not be reliable methods of blood loss quantification in a surgical setting.” (Jaramillo et al., 2018). Drawing a patient’s hematocrit, or serum blood level, during surgery is inaccurate due to constant, significant shifts from blood flowing out and intravenous fluids flowing in. Given this lack of accurate information, greater than 50% of all blood transfusions are considered unnecessary (Quian et al.,

2013), which are performed primarily out of concern from inaccurate blood loss estimation methodologies. This leads to high costs and waste of blood transfusions.

**INTERVENTION:**

First Quarter (Technical Accuracy): Testing ABLE prototype in OR for ease of use and accuracy of recorded data

Second Quarter (Clinical Correlation): Recording each surgery's ABLE Accurate Blood Loss estimate, and analyzing correlation with subjective EBL, vital signs, labs, and blood products transfused

Third Quarter (Backtesting Stage): Analyze 2nd quarter results and backtest to see if knowledge of the Accurate Blood Loss may have affected the need to transfuse or not (for example, at the time of decision to transfuse, if the surgical-anesthesia team had the ABLE number, would they still have transfused)

Fourth Quarter (Upgrade Stage): Use third quarter information to update the ABLE prototype and workflow, and estimate future cost savings based on data accumulated so far, and test upgraded version in the OR

The implementation of these solutions is anticipated to have a significant impact across various dimensions of healthcare. There is a potential reduction of adverse patient events (e.g., death, ICU admission, myocardial infarction, etc.) because of earlier recognition of accumulating blood loss during medical procedures. This proactive approach to monitoring blood loss can contribute to improved patient outcomes and overall safety. Additionally, the solutions aim to prevent unnecessary blood transfusions by reducing subjective overestimation of blood loss, thereby reducing the financial burden associated with blood management for hospitals. The introduction of an internal metric provides a valuable tool for benchmarking different types of procedures and evaluating the performance of surgical teams. This data can not only facilitate better decision-making but also allows for tracking improvements in accumulating blood loss over time. Overall, these solutions present a comprehensive approach to enhancing patient care, optimizing resource utilization, and fostering continuous improvement in surgical practices.

**RETURN ON INVESTMENT (ROI):**

This intraoperative device and software can make surgeries safer, save at least half a million per year in unnecessary blood transfusions from PRBCs alone (this can be extended to other types of blood products also), and has an accurate blood loss estimate to use as a metric for hospital analysis and national standards.

Our estimate for UCSF Parnassus (Moffitt-Long) hospital is extrapolated from 2022 Anesthesia data from Dr. Priya Ramaswamy's group:

Parnassus cases per year: ~22,939

Parnassus PRBCs transfused per year: 4,912

Cost per unit of PRBC: \$200 (per Dr. Ashok Nambiar, UCSF Blood Bank Director)  
Estimate % of intraoperative blood transfusion that is unnecessary over transfusion 49%  
(<https://www.sciencedirect.com/science/article/pii/S155372502200246X>)  
4,912 PRBC units \* 49% = 2,407 PRBC units unnecessary over transfusion  
2,407 \* \$200 = \$481,454 unnecessary PRBC costs per year at Parnassus alone for PRBCs alone

This is for one hospital only, and for PRBCs only (not counting the more expensive FFP, cryo, platelets that often go hand-in-hand with PRBCs). The savings should be even more for more hospitals (UCSF Mission Bay Adult, UCSF MB Peds, UCSF Mt. Zion, UCSF BCH Oakland).

We also did other estimates based on Tableau Clarity data, which are similar to the 2022 Anesthesia data.

### **SUSTAINABILITY:**

We hope to apply for future grants such as Caring Wisely, Catalyst, UCSF Innovation Ventures. Our executive sponsor Maimuna Sayyeda, and PI Alexander Lin, will plan for and budget operational resources to keep intervention going with the periop budget committees.

### **BUDGET:**

- Study coordinator \$20,000
- Statistical consulting (CTSI) \$5,000
- Hardware engineering modifications \$10,000
- Software development and integration \$10,000
- Informatics and database data scientist (Bakar Computing): \$5,000

### **References**

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Kollberg, Sandra E. et al. "Accuracy of Visually Estimated Blood Loss in Surgical Sponges by Members of the Surgical Team." *AANA Journal*, vol. 97, no. 4, Aug. 2019, pp. 277-284. <https://www.aana.com/docs/default-source/aana-journal-web-documents-1/accuracy-of-visually-estimated-blood-loss-in-surgical-sponges-by-members-of-the-surgical-team-august-2019.pdf>.

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