Self-Suturing Laparoscopic Port
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Motivation
Students in the SBME Clinical Immersion Program conducted field research on medical instruments at the Medical Center of the Rockies (MCR), a Level II Trauma Center. Several hundred hours were collectively spent in the operating room (OR) studying clinician-device-patient interactions, when the need for a novel laparoscopic device was identified.

Laparoscopic Surgery
Minimally Invasive
Faster Healing Time
Lower Risk of Infection
 Longer Operating Times

Figure 1: Laparoscopic instrumentation and abdominal access

Goal: Create a time-saving, laparoscopic suturing instrument that provides the patient with a proper abdominal closure

Goals and Design Process

Device Needs
• Safe
• Easy to Use
• Time saving

Process:
• Observe laparoscopic procedure w/ Dr. Dunn
• CAD with Creo & Solidworks
• 3D print with PLA
• Test & refine with advisors

Validation
• Failure Mode & Effect Analysis (FMEA)
• Finite Element Analysis (FEA)
• Discussions w/ advisors & surgeons

Self-Suturing Laparoscopic Device

Instrument Design

Figure 4: Final laparoscopic instrument design

Operational Procedure:
1. Insert the device into the incision with the wings in the vertical position until the bottom lid is flush with the skin.
2. Twist the plunger into the second lock (moves wings to the horizontal position) and insert the suture passer into one of the channels on the side and retrieve the suture from the wing.
3. Pull through the device and repeat for the other side.
4. Remove the device from the incision and tie the suture to close.

Figure 3: Example of a quality closure

Results

The team successfully completed an interrupted stitch using the device. The stitch secured the fascial and peritoneal layers of the suture pad while maintaining a 10mm anchoring of tissue. The device dimensions remained within the clinical constraints and allowed for quick retrieval of the suture from the wings.

Figure 5: Device securing fascial and peritoneal layers while anchoring 10mm of tissue

Acknowledgements
We would like to thank the following for their generous guidance and support: Brandon Krautz, Kevin Sniffen, and Dr. Mike Stanton for advising us throughout the Capstone project; Dr. Steven Dubes for allowing us to shadow in OR; Dr. Julie Dunn and Dr. Ellen Brennan-Pierce for their leadership during the Clinical Immersion Program; and Meghan Moll for her inception of the project and exemplary vision throughout its course.

References

User-device-environment interaction analyses were performed through interviews and ethnographic studies to ensure the project would be of desirable, functional use to its end users, the clinicians.

Conclusion & Future Work
The Capstone group was successful in bringing a student-led, original design concept to fruition. The novel laparoscopic instrument was directly designed around the needs of clinicians, and has the potential to offer safe, timely abdominal closure. In the future, this design may further developed using ethnographic studies to confirm OR reliability and ensure cost competitiveness.

Figure 2: Abdominal wall

Figure 6: Biaxial stress test to simulate abdominal insufflation

Figure 7: Lead screw to impart stress

Table 1: Von Mises stress and

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