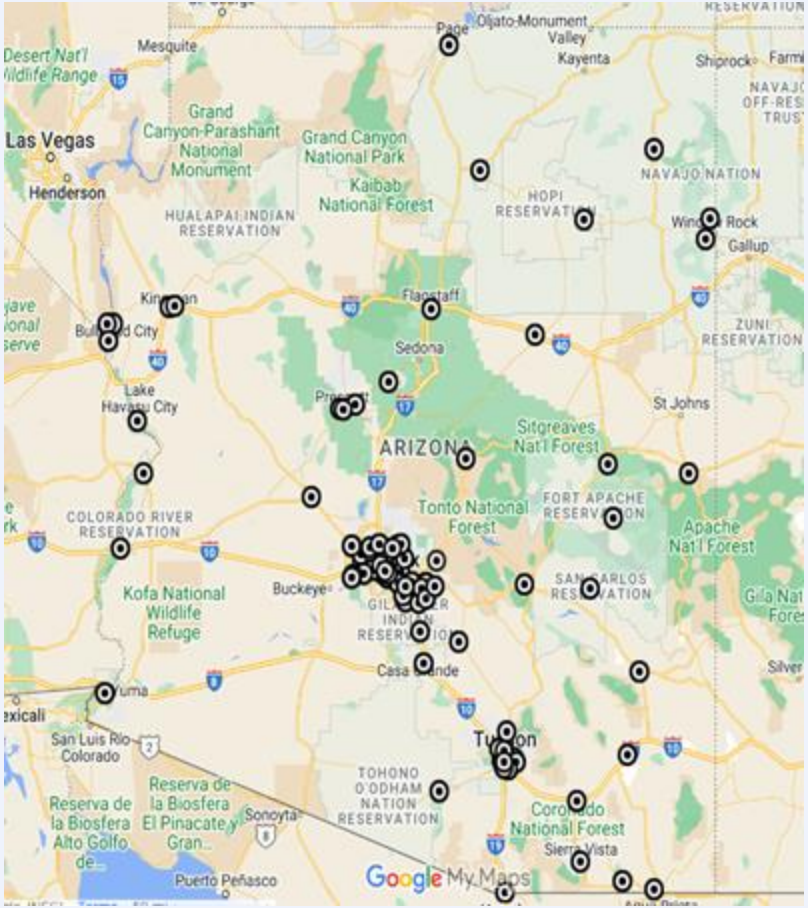
ECMO Bridge

Automated Medical Resource Allocation System

Engineering Projects in Community Service - 404
Stage 3



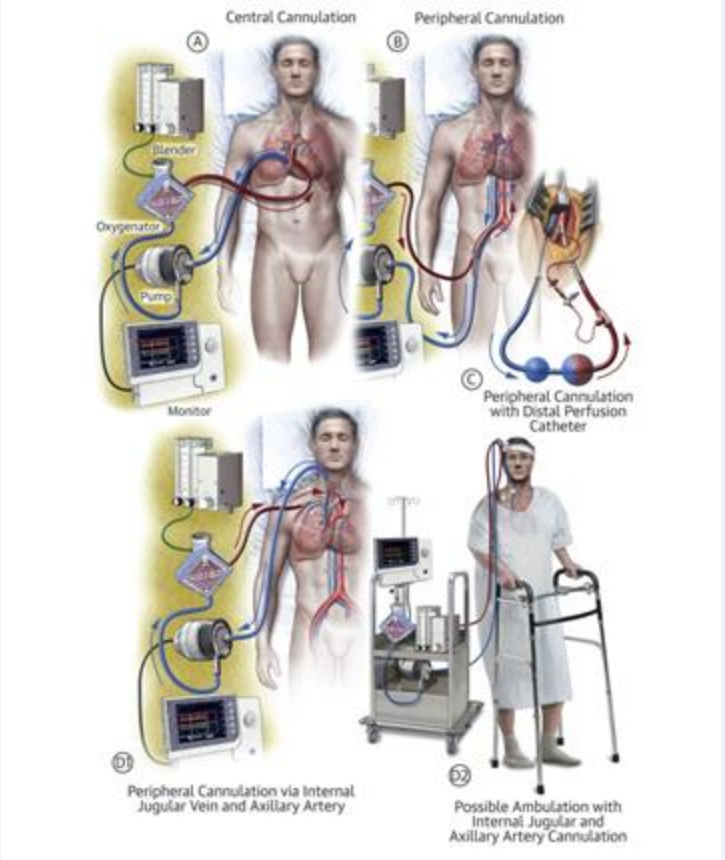
Background Of The Project

- **Stage 3** project (Began Fall 2023)
- Inspired by **COVID-19 Crisis Line**
- **Only 27** extracorporeal membrane oxygenation (ECMO) machines across Arizona
- Rural areas **underserved**
- Need for a **rapid response**

What is Extracorporeal Membrane Oxygenation (ECMO)

ECMO Machine is a form of life support designed to relieve pressure on the lungs and heart. Its purpose is to oxygenate and pump blood while removing CO2

Patients typically require an ECMO Machine's support for 5-10 days on average, however some may need it for several weeks.



Problem Statement

Here is Bob, a 52-year-old rancher from a small town in rural Arizona who needs an ECMO Machine's support to survive after a sudden infection. Unfortunately, the rural hospital has no ECMO Machines and the nearest device is in Phoenix, 3 hours away. When Bob's doctor calls to request a transfer, they learn all ECMO Units are currently in use, with no system to prioritize critical cases. Three days later, Bob is given an available ECMO Treatment, but the delay has complicated his treatment. Had Arizona implemented a centralized allocation system for tracking and distributing these life-saving devices, Bob could have received care much sooner, regardless of his rural location.

Consequences:

- Increased healthcare disparities [1]
- Delayed treatment [2]
- Lower survival rates [2]

[1] Olugboja, A. and Agbakwuru, E.M., 2024, February. Bridging healthcare disparities in rural areas of developing countries: leveraging artificial intelligence for equitable access. In 2024 International Conference on Artificial Intelligence, Computer, Data Sciences and Applications (ACDSA) (pp. 1-6). IEEE.
[2] Logan, Charles D., et al. "Rural-urban survival disparities for patients with surgically treated lung cancer." Journal of surgical oncology 126.7 (2022): 1341-1349.

Primary Stakeholders

Physicians Seeing Patients

- In urban hospitals
- **In medically underserved areas**
- In rural hospitals

Hospitals: Mayo Clinic

Patients and Families

Dr. Kyle Henry

Requirements

Need #	Requirements/Specifications	Spec #	Design Requirement
1	*Must have a way to automatically prioritize patients*	1.1	*Must be able to automatically decide priority of patient*
		1.2	*Must be able to assign different priorities to different criteria (age, severity, location)*
2	*Must have a way to determine the closest ECMO machine from the user's location*	2.1	*Must have the location of the hospital stored in the database for matching*
3	*Reduce lead time for patients to receive treatment*	3.1	*System must be automatic*
		3.2	*Must be able to match as soon as/before an ECMO becomes available*
		3.3	*Must be able to give several possible ECMO options for one patient*

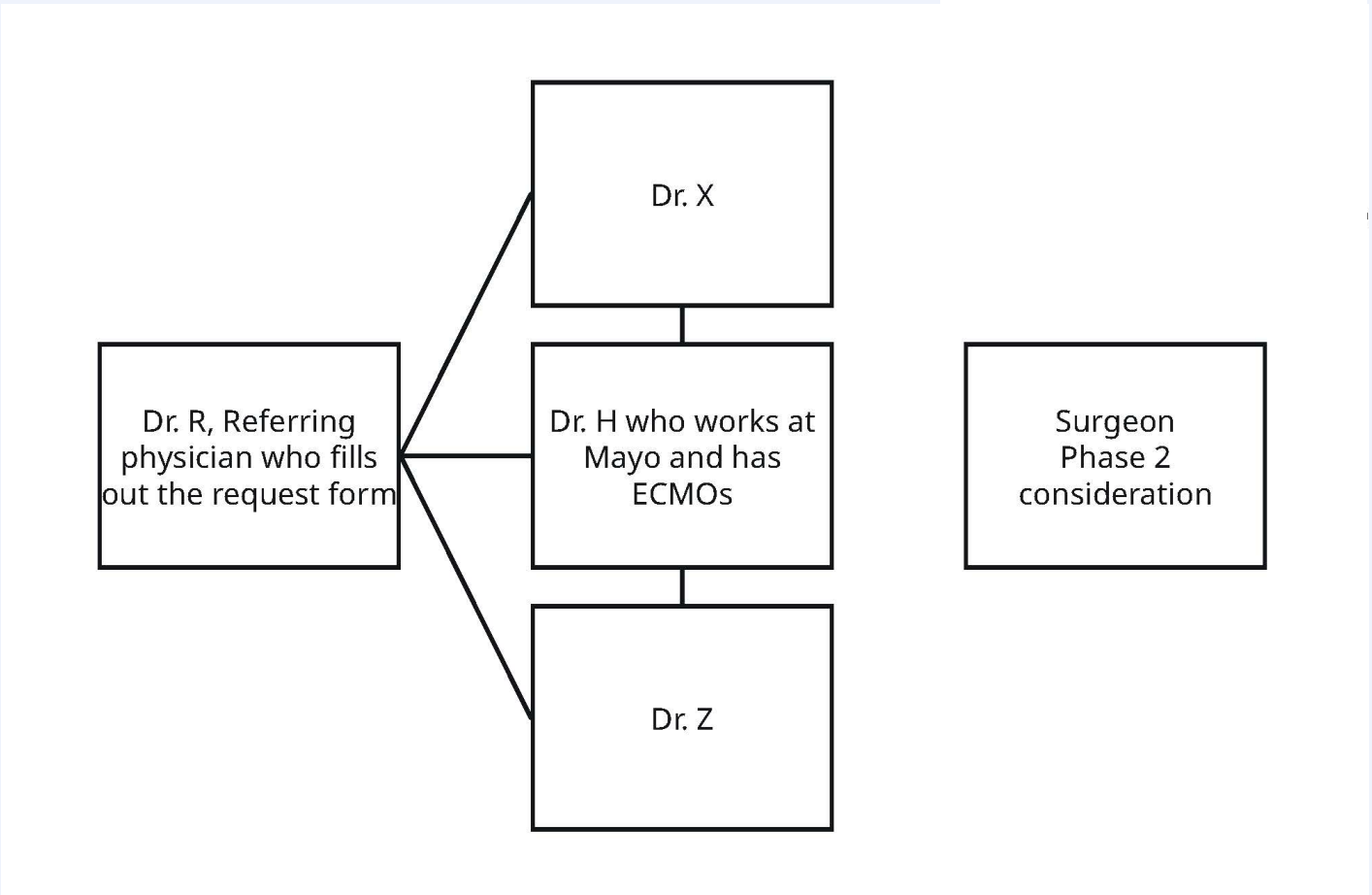
Brainstorming

Main Elements:

- App /desktop application with potential chat features 
- Hospital-exclusive log-in 

- App updates live to show EMCO usage 

Brainstorming



Brainstorming: ECMO Machine Bridge

Pros

- Improved user experience
- Faster interhospital communication
- Inexpensive
- Quick and seamless integration from matching patients to booking appointments

Cons

- Security concerns
- User education is required
- Difficulty in figuring out a standard for severity of patient's condition

Competitor Analysis

	FEATURES	ORG Struct	VALUE	COMPETENCE	Used by Hospitals	Color rating
ELSO	ECMO Allocation	Public Non-profit	Provides ECMO devices, uniform registry standard, equipment list	HIGH	Phoenix Children's Hospital, Mayo Clinic, Banner Health	Good
Luma Health	SMS Checkups, Appointment Scheduling, Virtual	Private	Streamlined, patient digital communication	Low	Dignity Health, HonorHealth	Bad
Ensocare	Trans-location communication	Private	Enables transferring of patients, while also handling referrals	High	Banner Health, Mayo Clinic	Good
Teledoc	Patient upkeep	Public	Ensures physical and mental health of patients	High	Mayo Clinic, Dignity Health	Good
EHealth	Patient Upkeep	Public	Medication admin, digi-checkups, digital care	High	HonorHealth, Banner Health	Good
Carequality	Data sharing	It's complicated	Ease of care transitions, provision of essential docs	Low	Phoenix Children's Hospital (limited adoption)	Bad
Epic Systems	Electronic health records/medical	Private	Comprehensive EHR system, real-time data	High	Mayo Clinic, Banner Health, Dignity Health	

Current Product (Live Demo)

Prototyping Process

Prototyping Focus for this Semester:

- **Finalize the prototype:** Build upon last semester's initial UI design and basic prototype.
- **Backend integration:** Develop and implement logic for ECMO allocation based on predefined criteria, linking it to the user interface.
- **Variable refinement:** Adjust and measure variables related to ECMO allocation efficiency and UI/UX usability as part of the prototyping process.
- **Design documentation:** Continuously update design documents as refinements are made.

Iterative feedback: Regular meetings with the community partner as well as user surveys to gather feedback to refine the prototype.

Impact of Solution

- **Challenges with the current ECMO device systems**
  - **No System** currently in place
  - **Lack of awareness** of device benefits
  - **Delays** in life-saving treatment

- **Solutions our design provides**
  - **Eliminates wait times** in treatment assignment
  - **Enables patient choice** in hospitals
  - **Relieves** hospitals of repetitive tasks

Next Steps

Timeline:

Prototype Debugging	02/10/25
App stress testing and design refinement (Iteration 1)	02/10/25
Additional feature implementation	02/20/25
App stress testing and design refinement (Iteration 2)	02/20/25
Implementation of feedback from stakeholders	03/05/25

Engineering and Design Challenges

What would be an effective way to introduce this application to hospital administrators?

What fail safe features can we incorporate to better protect the privacy of patients?

What are some measures we could take to better serve patients in rural areas?

Thank You!

Question and Answer Portion