**Bergen, Norway**
May 19, 2025

# Blood Availability in Remote and Austere Environments


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HARVARD MEDICAL SCHOOL | BLAVATNIK INSTITUTE GLOBAL HEALTH & SOCIAL MEDICINE, PROGRAM IN GLOBAL SURGERY AND SOCIAL CHANGE | Brigham and Women's Hospital, Founding Member, Mass General Brigham

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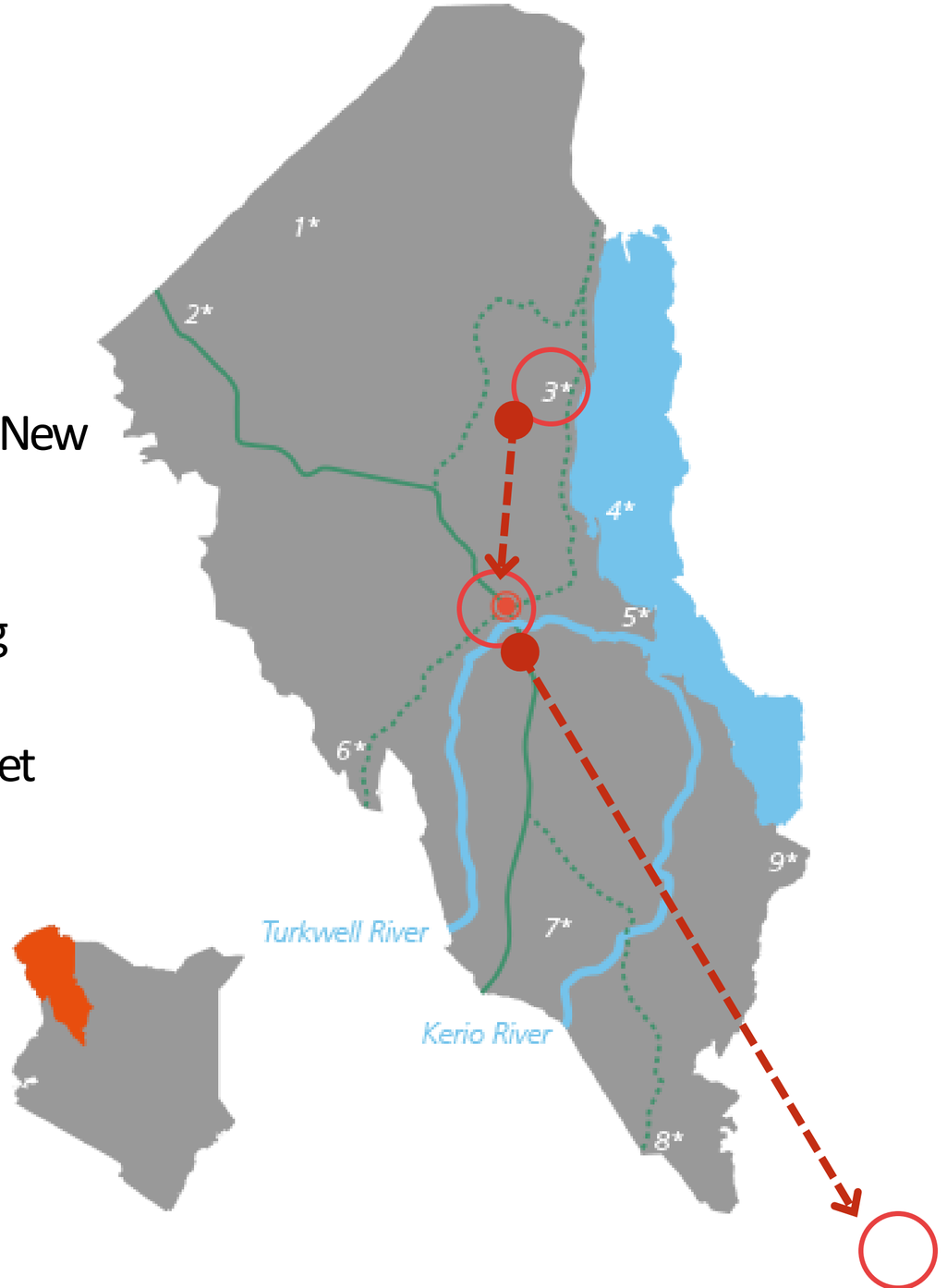
LIFE•BLOOD LOCAL INITIATIVE FOR EMERGENCY BLOOD


Turkana County, Kenya

# The Tragedy of Ernestina

- Presents to Nariokatome Clinic with New Years Eve 2023, 30 weeks pregnant
- Hgb 3
- Transferred to Lodwar early morning
- No blood
- Waits 4 days before transfer to Eldoret
- Mother and baby, dead

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**102** million unit shortage in LMICs

Articles

# The global need and availability of blood products: a modelling study

Nicholas Roberts, Spencer James, Meghan Delaney, Christina Fitzmaurice

## Summary

**Background** Blood transfusions are an important resource of every health-care system, with often limited supply in low-income and middle-income countries; however, the degree of unmet need for blood transfusions is often unknown. We therefore aimed to estimate the blood transfusion need and supply at national level to determine gaps in transfusion services globally.

**Methods** We did a modelling study involving 195 countries and territories. We used blood component preparation data from 2011–13 to estimate blood availability for 180 (92%) of 195 countries from the WHO Global Status Report on Blood Safety and Availability. We calculated disease-specific transfusion needs per prevalent case for 20 causes in the USA using the National (Nationwide) Inpatient Sample dataset between the years 2000 and 2014, and the State Inpatient Databases between 2003 and 2007 from the Healthcare Cost and Utilization Project. Using prevalence estimates for the USA from the Global Burden of Disease (GBD) 2017 study, we estimated the ideal disease specific-transfusion rate as the lowest rate from the years 2000 to 2014. We applied this rate to GBD prevalence results for 195 countries to estimate transfusion needs. Unmet need was the difference between the estimated supply and need.

**Findings** In 2017, the global blood need was 304 711 244 (95% uncertainty interval [UI] 293 064 637–314 049 479) and the global blood supply was 272 270 243 (268 002 639–276 698 494) blood product units, with a need-to-supply ratio of 1·12 (95% UI 1·07–1·16). Of the 195 countries, 119 (61%) did not have sufficient blood supply to meet their need. Across these 119 countries, the unmet need totalled 102 359 632 (95% UI 93 381 710–111 360 725) blood product units, equal to 1849 (1687–2011) units per 100 000 population globally. Every country in central, eastern, and western sub-Saharan Africa, Oceania, and south Asia had insufficient blood to meet their needs.

**Interpretation** Our data suggest that the gap between need and supply is large in many low-income and middle-income countries, and reinforce that the WHO target of 10–20 donations per 1000 population is an underestimate for many countries. A continuous expansion and optimisation of national transfusion services and implementation of evidence-based strategies for blood availability is needed globally, as is more government support, financially, structurally, and through establishment of a regulatory oversight to ensure supply, quality, and safety in low-income and middle-income countries.

**Funding** National Institutes of Health.



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See **Comment** page e598

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Almost **every single country** in Sub Saharan Africa, South Asia, and Oceania is in deficit

# Worse than blood shortage: **blood desert**

**There is <u>no blood</u> in a blood desert**

- Hours or days away from nearest facility with stocked blood
- Billions worldwide live in blood deserts


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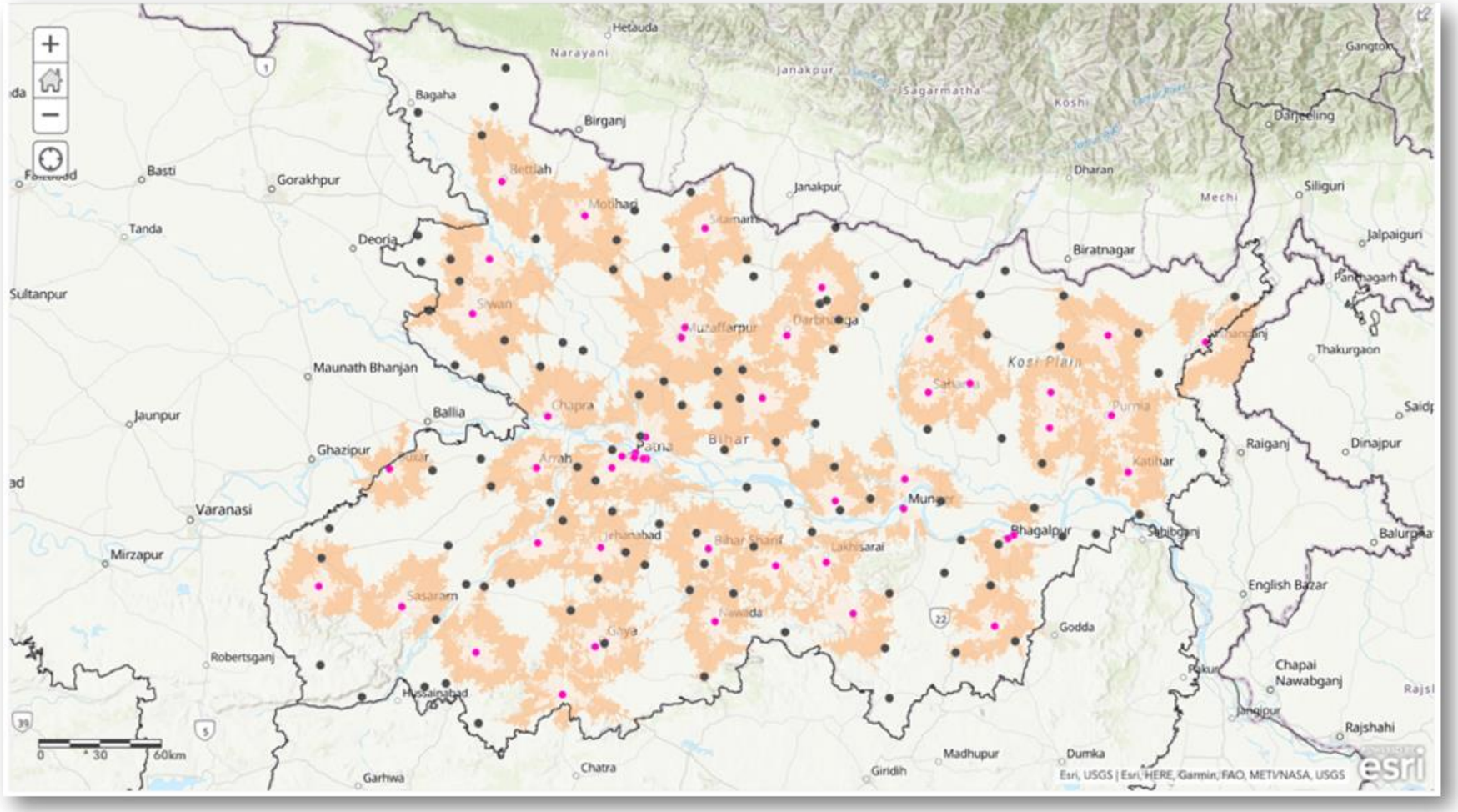
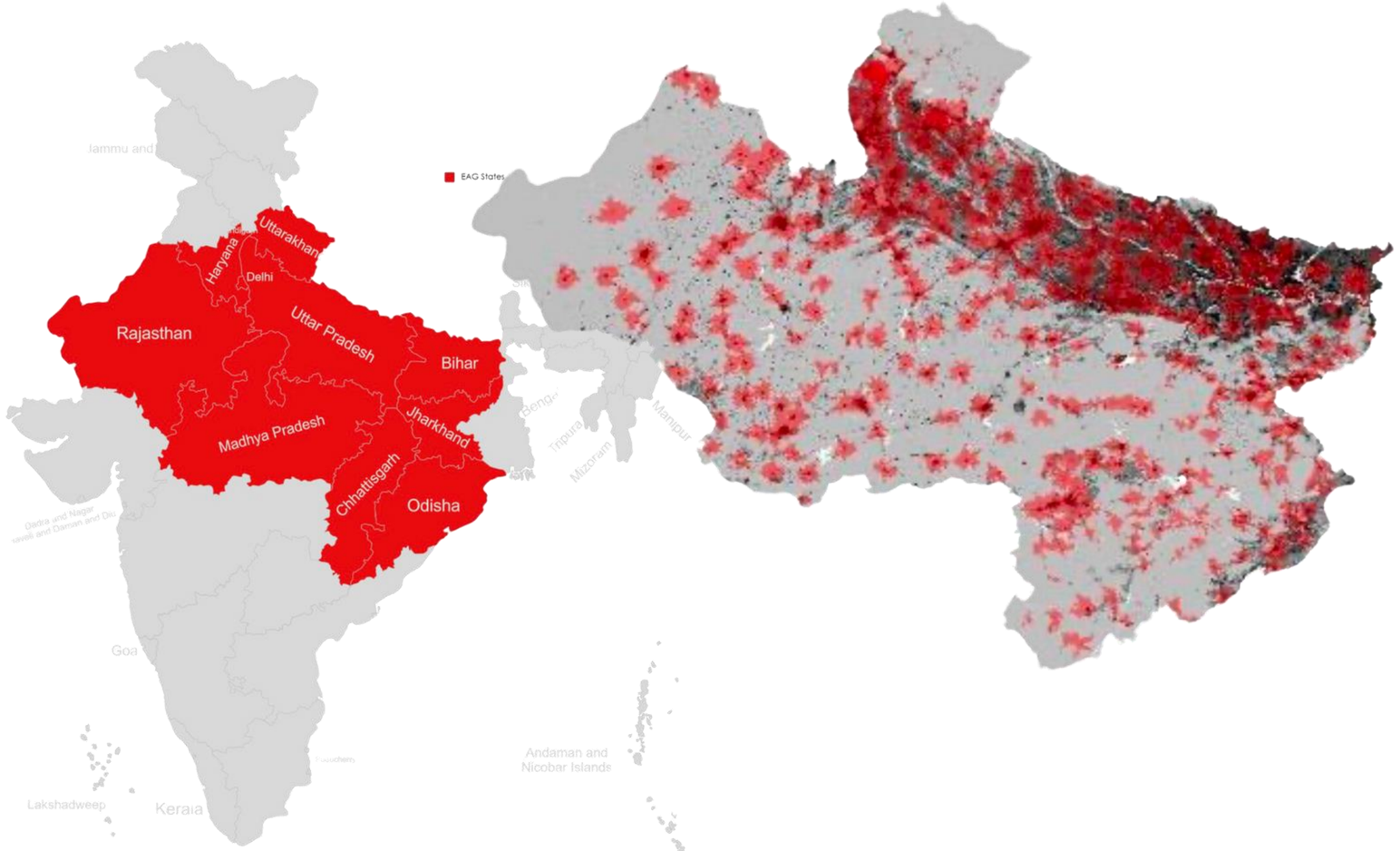
# 70% First Referral Units in Bihar, India Do Not Have A Blood Bank




*Pendleton A, Dutta R et al. What to scale first? A cross-sectional analysis of factors affecting cesarean section delivery rates at first referral units in Bihar, India. Global Health Action, 2023.*

# Less than half of the population of Northern Indian states live within 60 minutes of a blood bank

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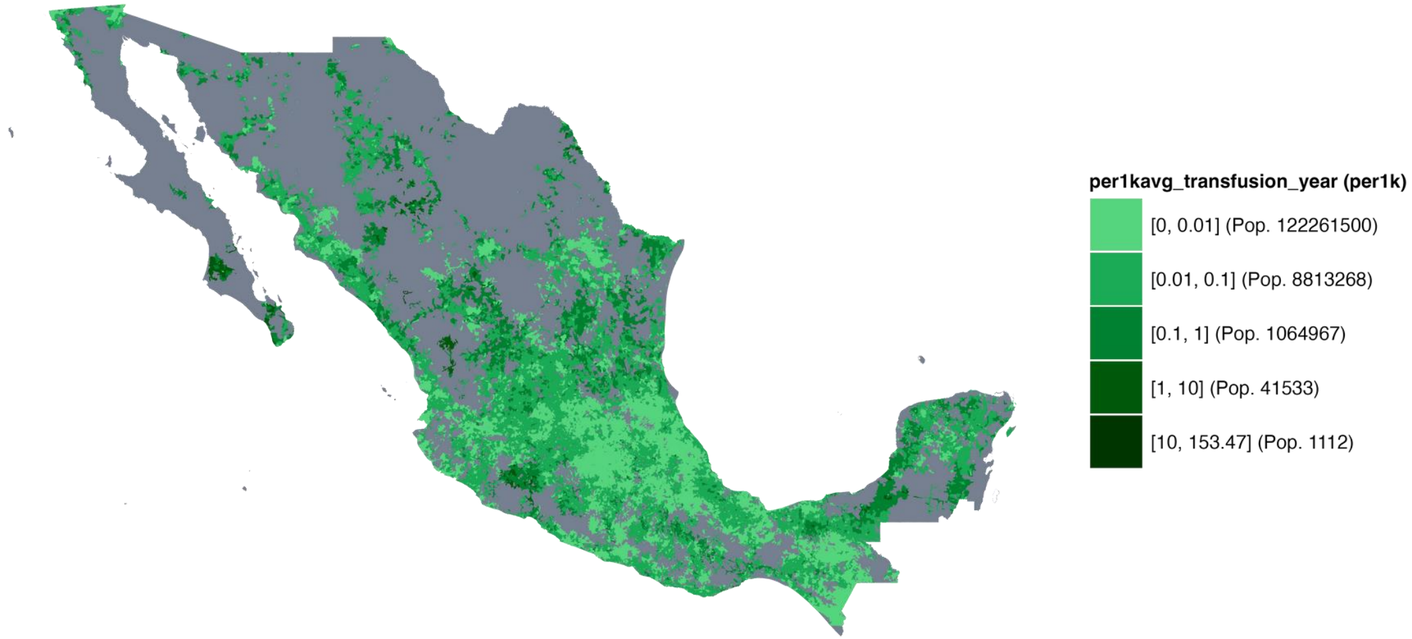
*Kundu S, Munoz-Valencia A et al. Defining Blood Deserts and Access to Blood Products for 660 Million People: A Geospatial Analysis of Eight States in Northern India. BMJ Global Health 2024.*

# Less than 2% of the population of Mexico has access to >10 transfusions/1000

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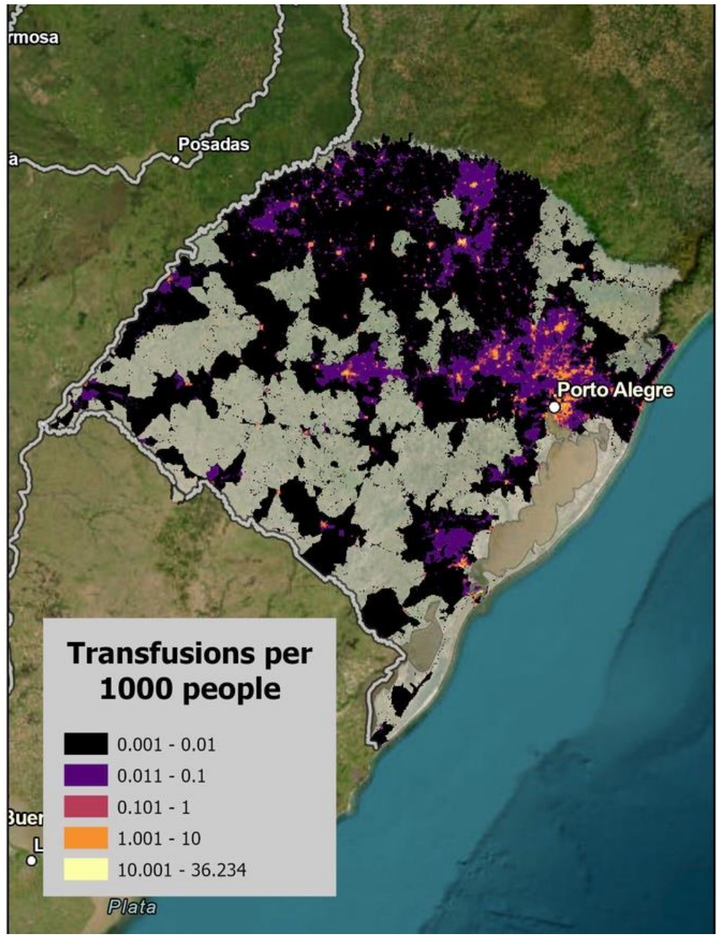
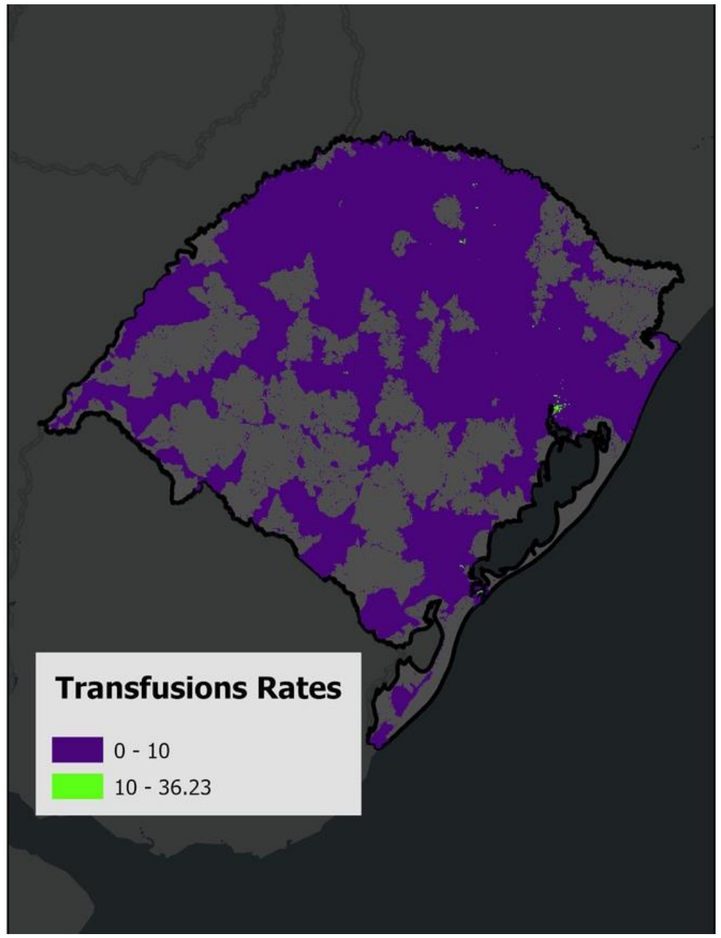
*Courtesy Nikathan Kumar, 2025. Unpublished data.*

# Less than 1% of the population of Rio Grande Do Sul has access to >10 transfusions/1000

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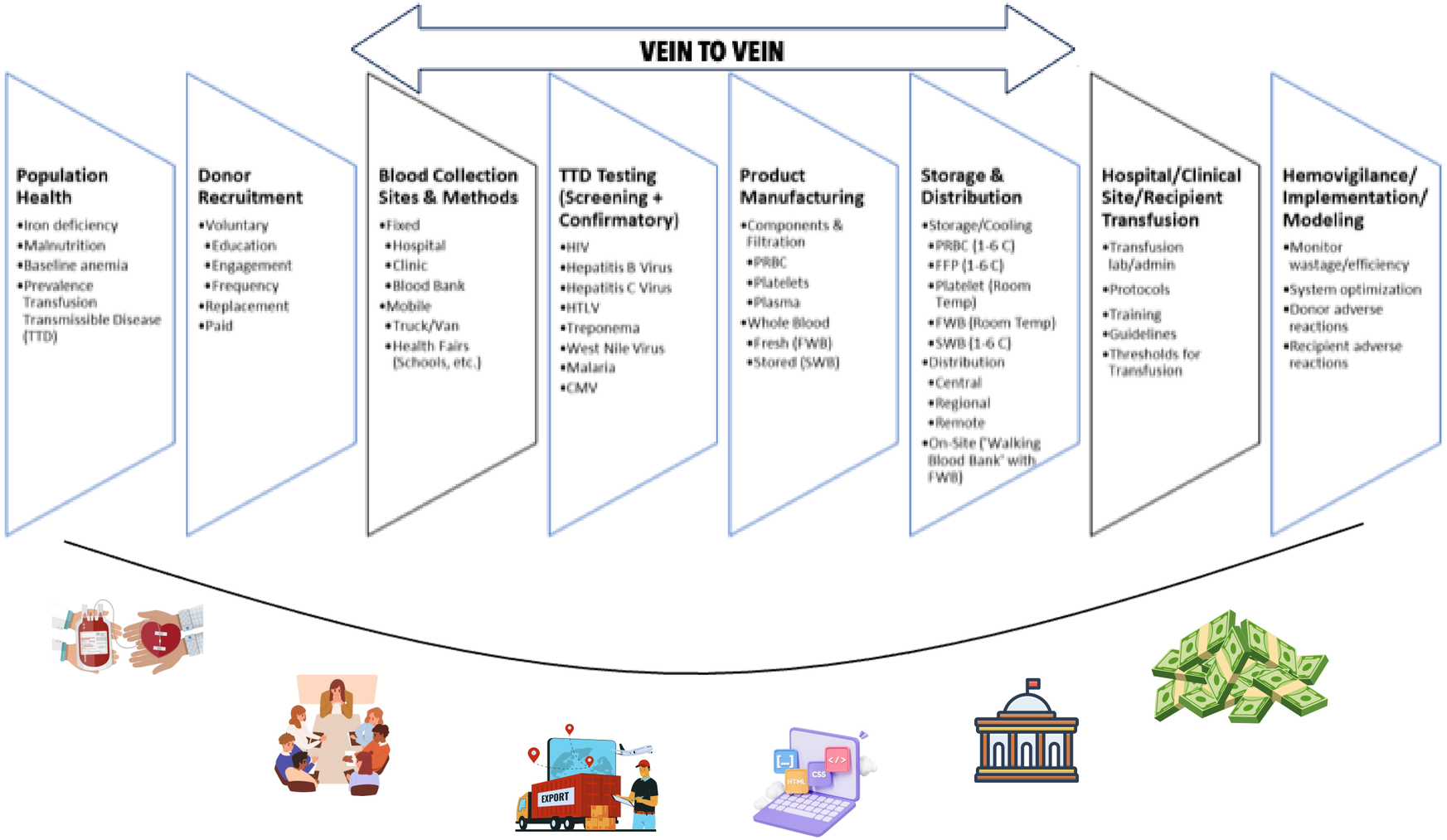
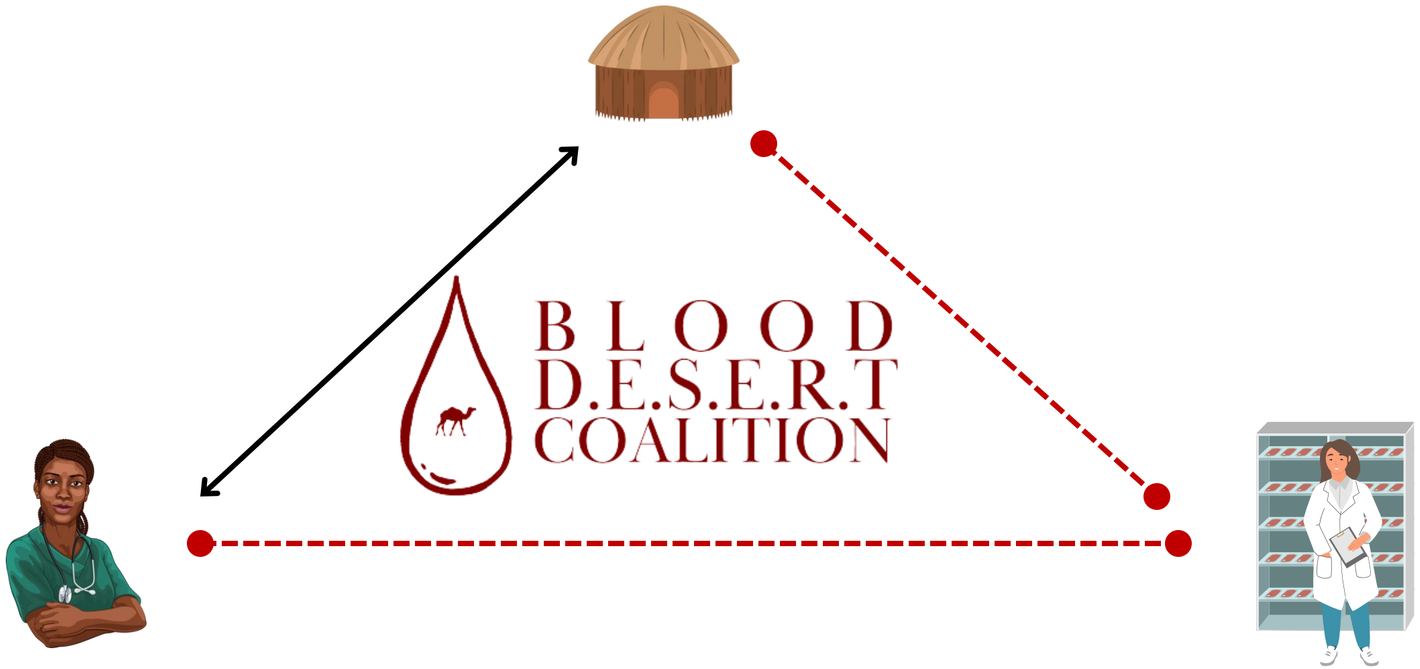
*Courtesy Nikathan Kumar, 2025. Unpublished data.*

# Blood banking is logistically complex and expensive



# Why?

## The Blood Desert Trifecta of Invisibility

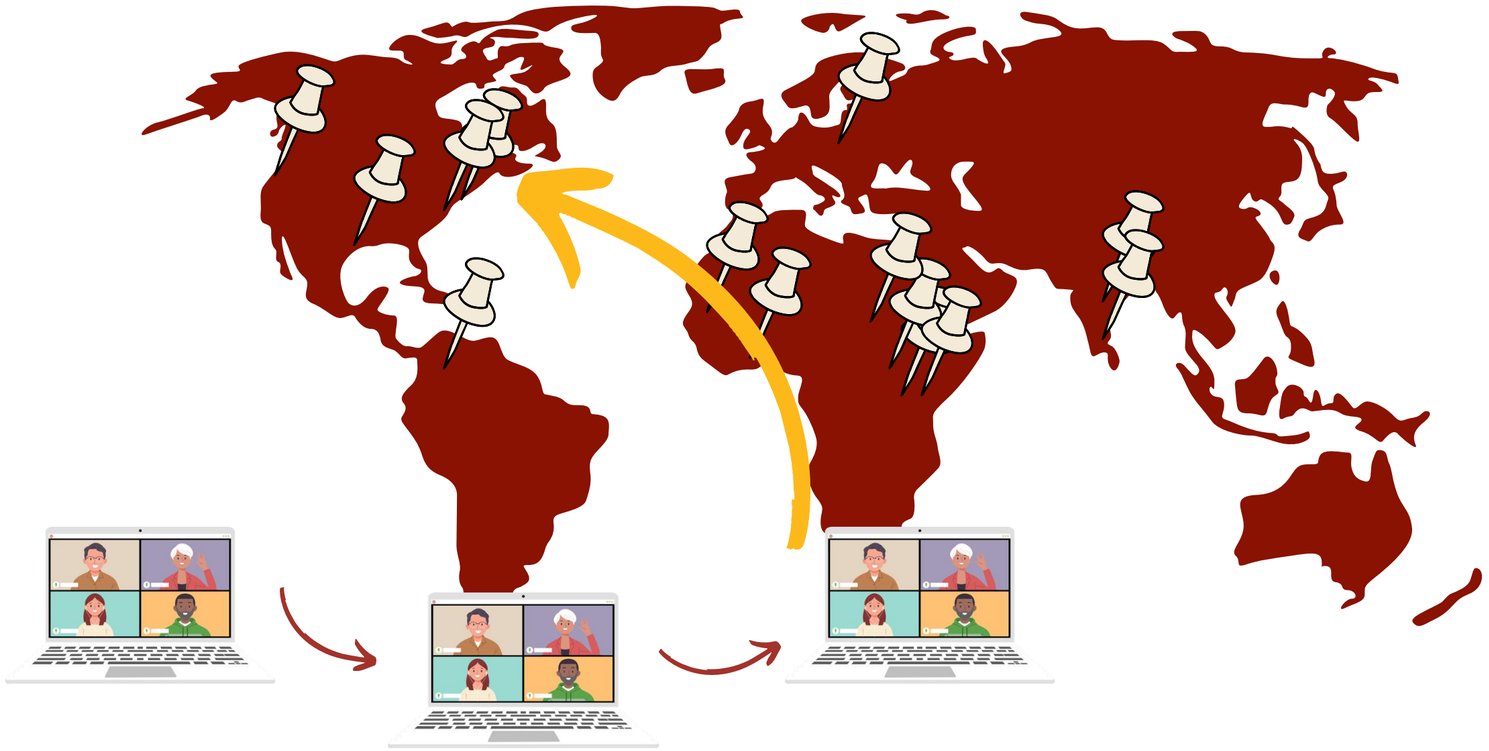


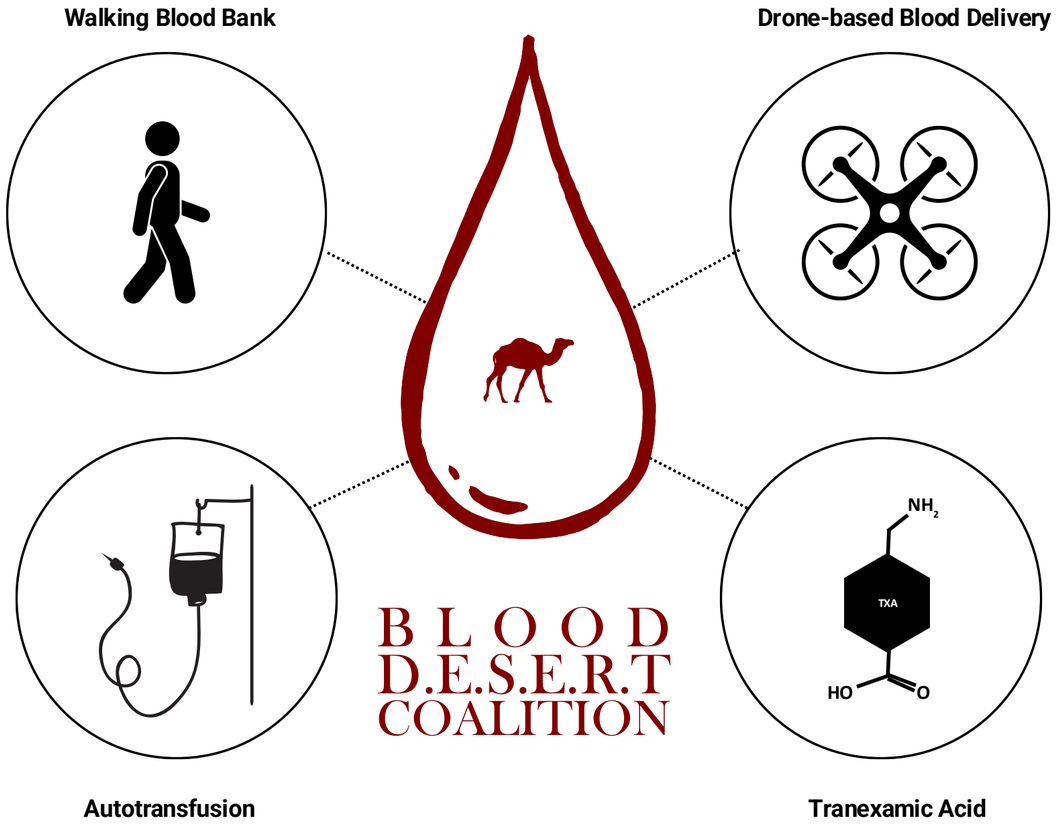
**Blood**

**D**elivery via **E**merging **S**trategies for **E**mergency **R**emote **T**ransfusion

**Coalition**

Clinicians, researchers, experts in military and civilian transfusion, policy, and patient advocacy






## VISION

No one should die from lack of blood transfusion.

## MISSION

Establish the research, education, implementation agenda needed to eliminate the world's blood deserts.

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# Innovative Blood Transfusion Strategies To Address Global Blood Deserts

THE LANCET
Global Health

VIEWPOINT | VOLUME 12, ISSUE 3, E522-E529, MARCH 2024 Download Full Issue

Innovative blood transfusion strategies to address global blood deserts: a consensus statement from the Blood Delivery via Emerging Strategies for Emergency Remote Transfusion (Blood DESERT) Coalition

Prof Nakul P Raykar, MD MPH • Vanitha Raguveer • Yetmgeta Eyayou Abdella, MD MPH • Asma Ali-Awadh, MBChB MIPH • Harshit Arora, MBBS • Prof Lucy Asamoah-Akuoko, MD PhD • Prof Linda S Barnes, DrPH MHA • Prof Andrew P Cap, MD PhD • Aulina Chowdhury, DO • Prof Zara Cooper, MD MSc • Prof Meghan Delaney, DO MPH • Marisa DelSignore • Sidra Inam, MBBS • Prof Vijay Anand Ismavel, MS MCh • Kennedy Jensen, MD • Nikathan Kumar, MD MS • Gilchrist Lokoel, MBChB • Prof Joy John Mammen, MD • Priyansh Nathani, MBBS • Marie Paul Nisingizwe, MS PhD • Prof Juan Carlos Puyana, MD • Prof Robert Riviello, MD MPH • Prof Nobhojit Roy, MD PhD • Prof Ali Salim, MD • Prof Claude Tayou-Tagny, MD MS • Sargun Virk, MBBS • Caroline Wesonga Wangamati, MSc MA • Show less • Show footnotes

Open Access • Published: March, 2024 • DOI: https://doi.org/10.1016/S2214-109X(23)00564-8 •

Check for updates

- **A blood desert is** a geographic region where essential clinical demand for blood components cannot be met at the point-of-care in a timely, affordable manner, in at least 75% of cases
- **Blood unavailability metrics** (unmet demand and stockouts) should be reported at facillity, regional, and national levels.
- **Walking blood bank regulatory/policy provisions** are essential where no reliable alternatives exist

**www.blooddesertcoalition.org**

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*Raykar N, Raguveer V et al. Innovative Blood Transfusion Strategies To Address Global Blood Deserts, The Lancet Global Health, 2024*

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COALITION

# Walking Blood Bank Implementation Project in Turkana County, Kenya

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**Study Setting**

- Lodwar County Referral Hospital
- Has a ‘satellite’ blood bank
  - No official blood screening capacity on-site
  - Testing sent to Eldoret; results 3-14 days

**What is the nature of blood insufficiency** at the facility level in a blood desert? Is it amenable to a WBB approach?

**Is a WBB approach feasible** in this context?

I**s a WBB approach “safe”** in this environment (high TTI rates, concerns over RDT)?

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# Walking Blood Bank Implementation Project in Turkana County, Kenya

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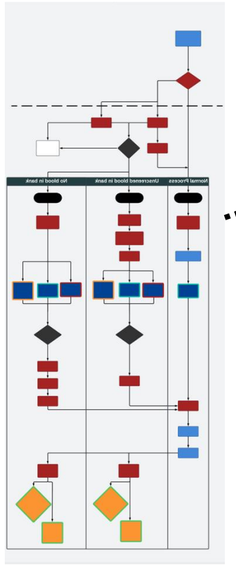
**WBB**

LCRH

**NEED**
- Stockouts occurred 1 in 3 days
- Demand is less than 2% of expected need, only 85% met

**FEASIBILITY**
- RDT use is necessary
- Standardized processes are needed
- Shared decision making is essential
- RDTs may be unsafe

**SAFETY**
- TTI prevalence for donors was 5.4%
- RDTs had a 99.2% negative predictive value compared to ELISA



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**WBB**

LCRH+2 SubCounty Hospitals

**ESTABLISH AND IMPLEMENT**
- Emergency Transfusion Protocol
- Context adaptive, multi-stakeholder
- Hospital transfusion committee-led implementation

**EVALUATE**
- Time-to-transfusion, unmet blood need
- Clinician perceptions demand
- Staff qualitative impact assessment
- Patients and family perspectives

**ADAPT**
- Assess transferrability to lower-resourced contexts

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LIFE•BLOOD 3

LOCAL INITIATIVES FOR EMERGENCY BLOOD


TXA WBB IAT DBD

LCRH + 13 SubCounty Hospitals

# Mixed-methods, multicenter effectiveness-implementation hybrid trial

**Quantitative Components**
- Baseline data collection on blood bank statistics
- Hemorrhage/shock incidence rates
- Clinical outcomes measurements
- Cost effectiveness analyses
- Protocol adherence rates
- Time-to-treatment metrics

**Qualitative Components:**
- Stakeholder interviews about implementation barriers
- Provider feedback on protocols
- Process evaluations
- Implementation feasibility assessments

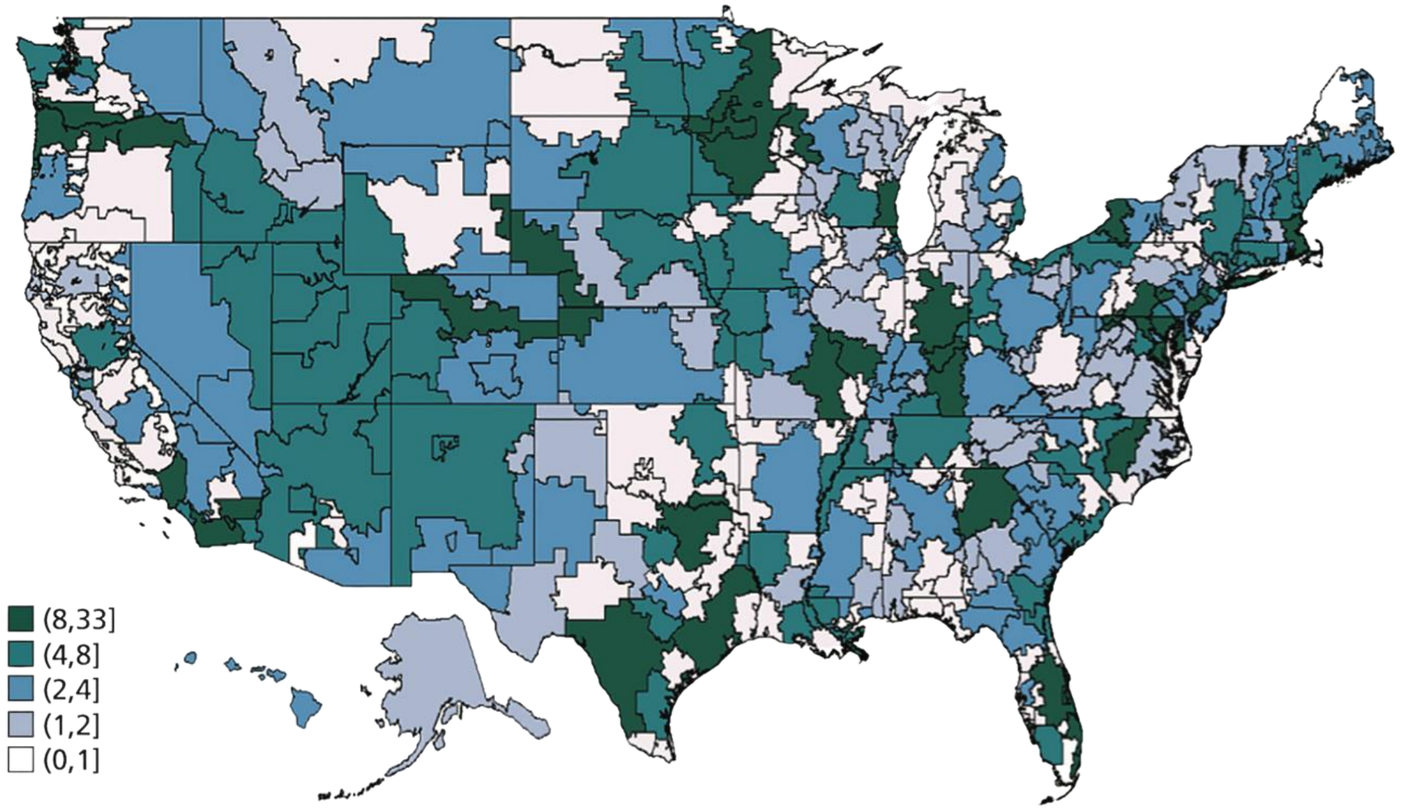
**Geospatial/Modeling Components:**
- Geospatial analysis for drone assessment
- Validated model for risk prediction rapid diagnostic test usage

**Implementation Research :**
- Focuses on testing strategies to promote adoption of evidence-based interventions
- Studies barriers and facilitators to implementation
- Evaluates implementation outcomes (feasibility, acceptability, sustainability)
- Aims to understand how interventions work in real-world settings, diverse contexts

**Effectiveness Research**
1. Tests clinical interventions (TXA, CWBB, autotransfusion, drone delivery) on ability to reduce blood transfusion need or time-to-transfusion
2. Establishes performance of testing platform for CWBB in diverse range of settings
3. Establishes effectiveness of various modalities of autotransfusion

# Are blood deserts just an LMIC problem?

# # Unique Blood ‘Establishments’ Registered with FDA per Hospital Referral Region, 2016




SOURCE: RAND analysis of FDA Form 2830 data by hospital referral region (HRR). See Chapter Three for more details.

RAND *RR1575-2.*


- 70% critical access hospitals had a ‘24/7’ blood bank but staff shortages, lack of inventory, lack of testing capability common
- 20.6% did not hold any blood products in inventory
- 2.6% hospitals had the capacity to transfuse PRBC, plasma, and platelets simultaneously
- Average time to next closest facility: 4 hours

*“We are a rural facility with a surgeon: we have challenges maintaining adequate blood without overstock.”*

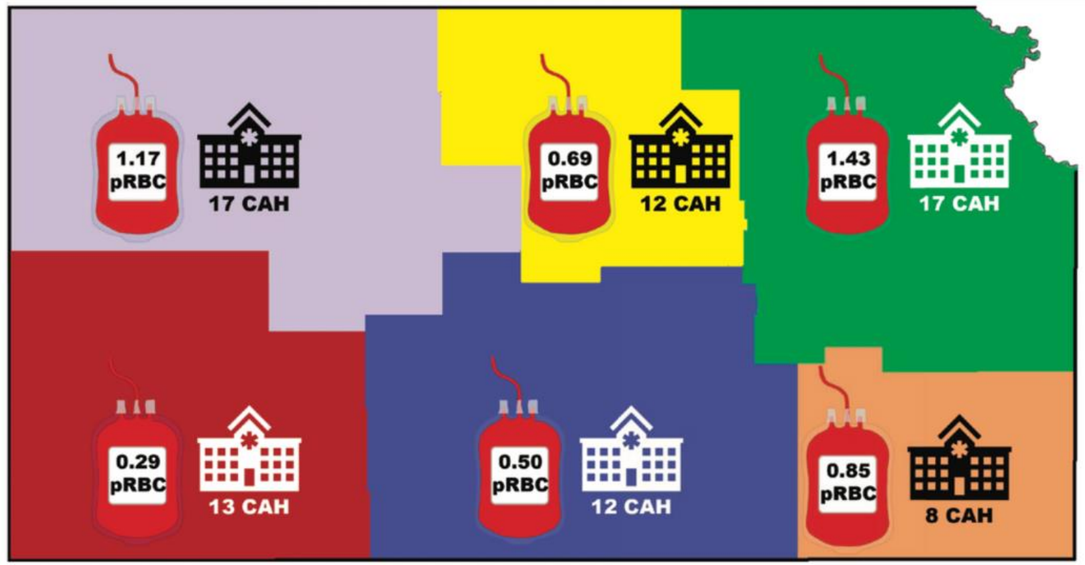
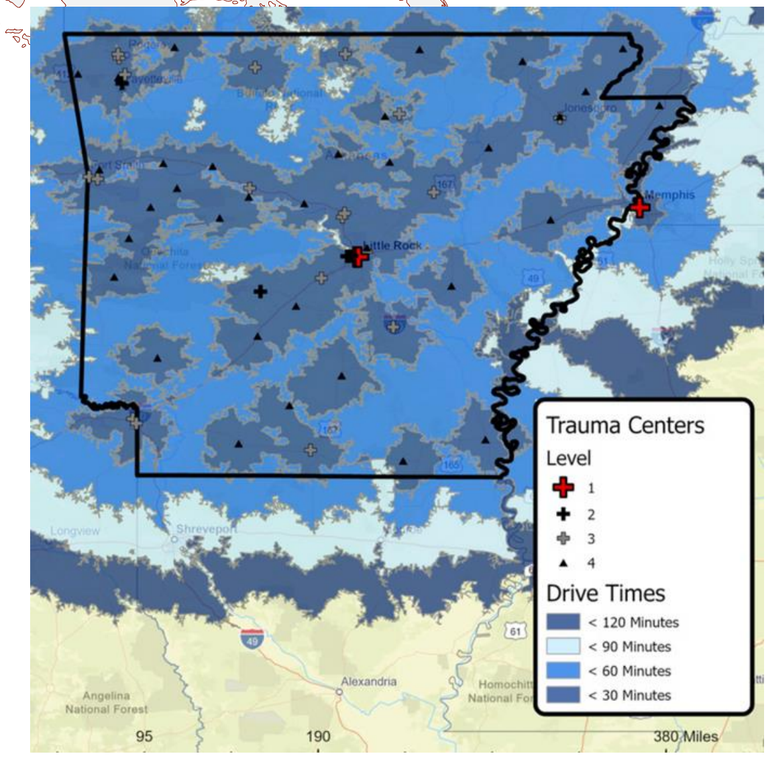



**FIGURE 1** Rate of packed red blood cell products per 1000 population in nonmetropolitan counties (RUCC 4-9) and total CAH by KHA region in 2023.
CAH, critical access hospital; KHA, Kansas Hospital Association; pRBC, packed red blood cells; RUCC, rural-urban continuum code

Nunez-Argote et al, Am J Clin Pathol, 2024.

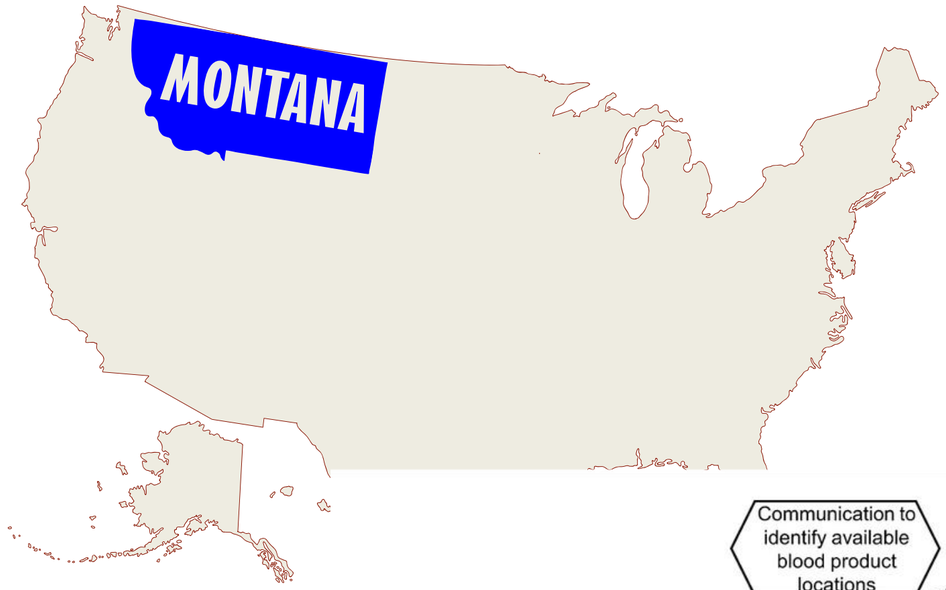

# Only 16% of trauma centers in Arkansas have access to balanced blood resuscitation




- 64 Trauma Centers (Levels I-IV); severe limitation in never-thawed FFP and platelets
- Only 60% of population within balanced resuscitation capacity within 60 minutes

*Smedley et al. The American Surgeon, 2023*

# Montana Interfacility Blood Transport Network




- Large rural landmass, extended transfer times
- Weather frequently restricts air transport
- Comprehensive blood sharing program between critical access hospitals, supported by emergency services, to facilitate blood products resuscitation en route of transfer

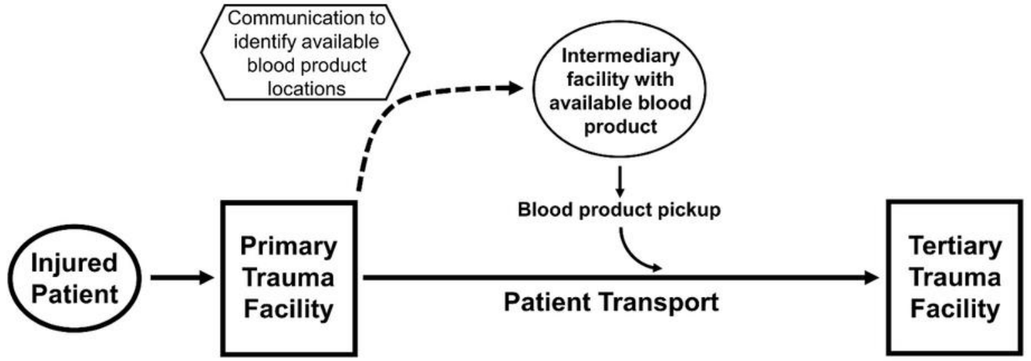



**Figure 3** Diagrammatic Representation of the Montana Interfacility Blood Network Concept. Primary trauma facility refers to the first hospital facility a trauma patient arrives post-injury. Tertiary trauma facility refers to the highest level of appropriate trauma care for the patient.

Riha et al. Journal of Blood Medicine, 2024

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SUPPLEMENT ARTICLE

TRANSFUSION

# Civilian walking blood bank emergency preparedness plan

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Civilian walking blood banks are the ultimate, resilient backup strategy

- Mass casualty
- Disaster
- Supply chain disruptions
- Acute on chronic shortages
- Large scale combat operations

# A Civilian WBB program in the United States (STBTC & STRAC)


- Primarily an emergency whole blood program during standard operations- a comprehensive rotation system cold-stored WB for emergency prehospital, in-hospital use
- Maintains donor pool of male, low-titer O-positive WB

Braverman et al, Transfusion 2020; Braverman et al Transfusion 2022; Brigmon et al, TSACO 2024

# Blood Availability in Remote and Austere Environments

- **Massive shortage of banked blood** available for transfusion worldwide; blood deserts present in LMIC and HICs
- **Urgent need** to recognize the problem
- **CWBBs** are the ulitimate resilience measure. **Adaptations will be necessary** to local context based on workforce constraints, training, and TTI prevalence
- **Coordinated** research, implementation, policy, and advocacy efforts necessary

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