UN SDG 3:
Ensure Healthy Lives and Promote Well-Being For All Ages

Target 3.2.2:
By 2030, end preventable deaths of newborns and children under 1 month of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births.

UN SDG 3:
Ensure Healthy Lives and Promote Well-Being For All Ages

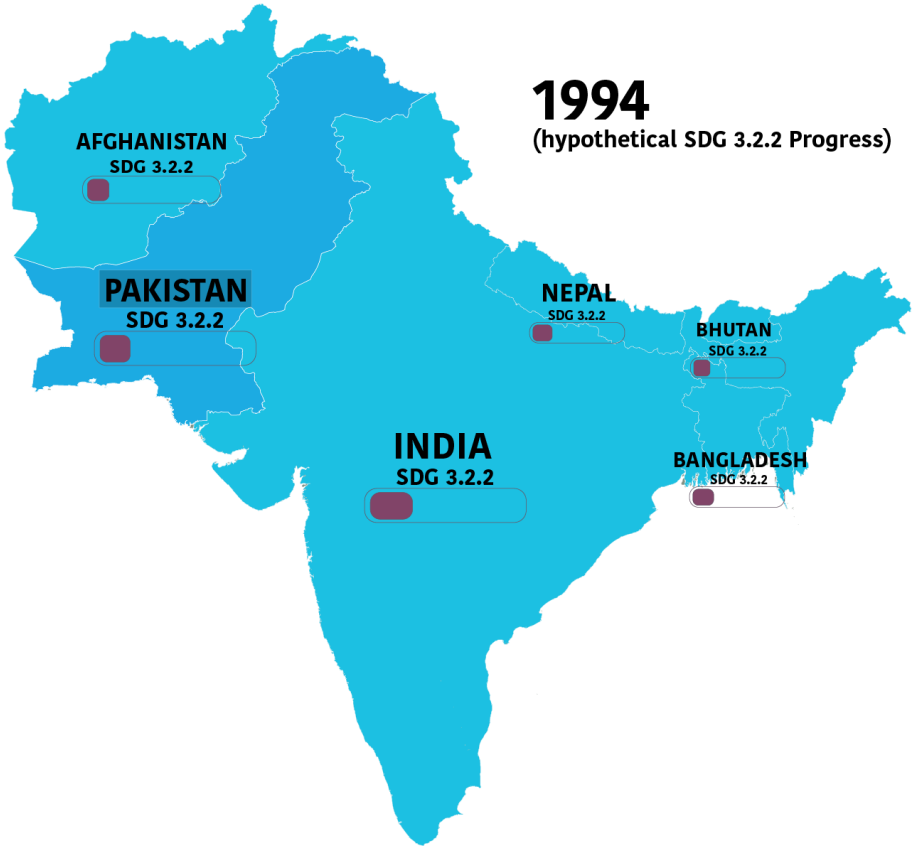
Target 3.2.2:
By 2030, end preventable deaths of newborns and children under 1 month of age.

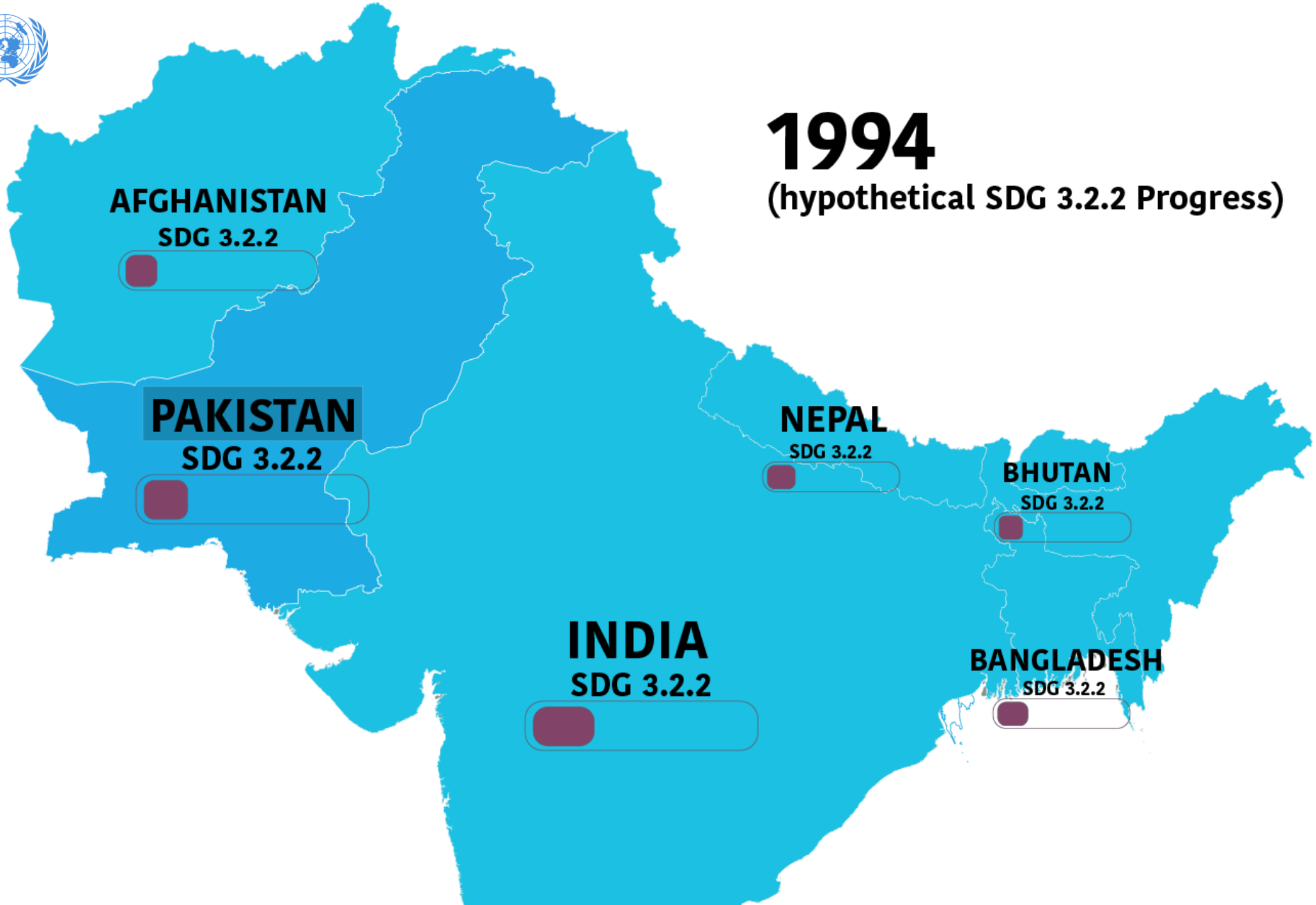
Project S.O.S

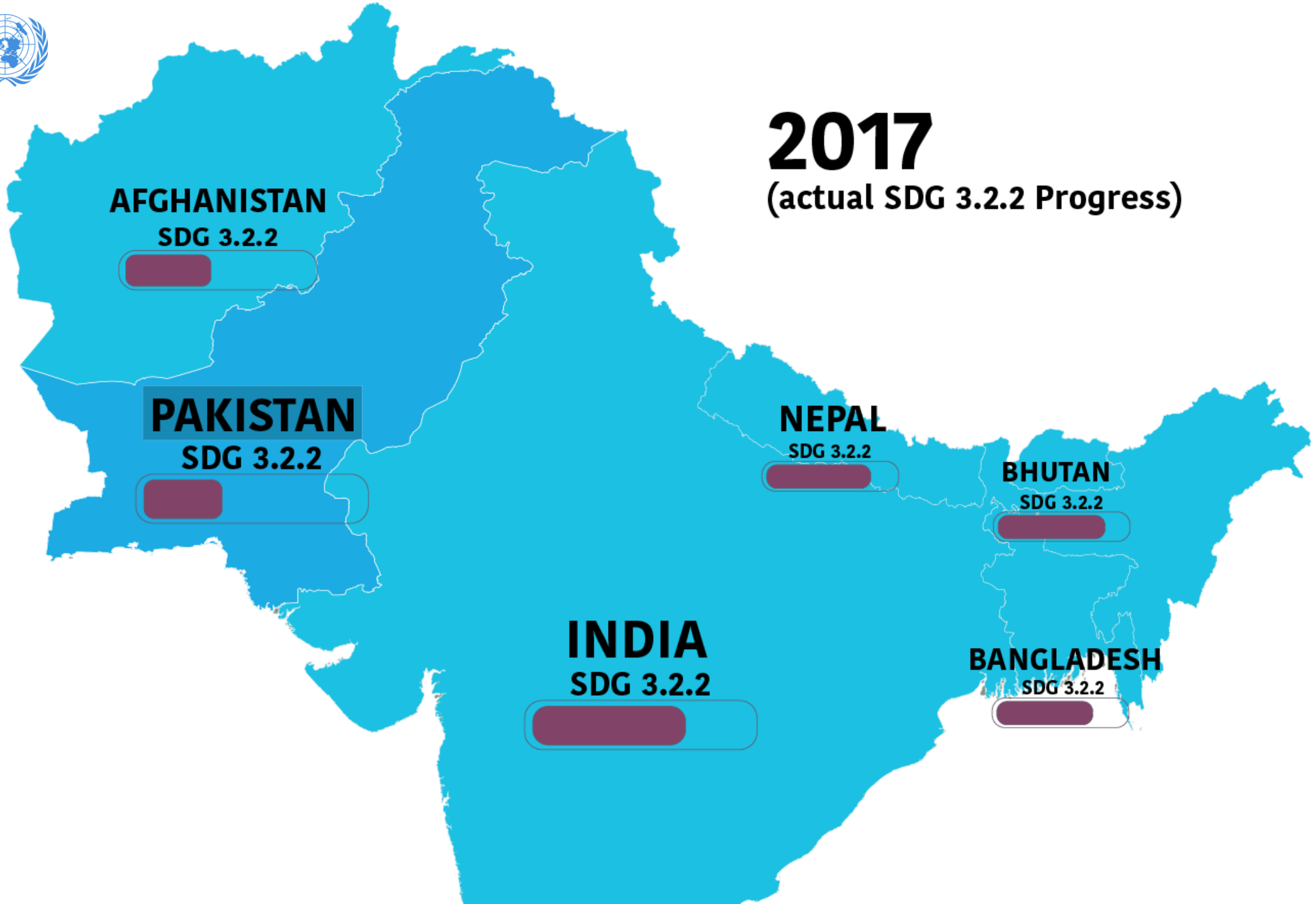
Solving **O**mphalitis with **S**olar Power

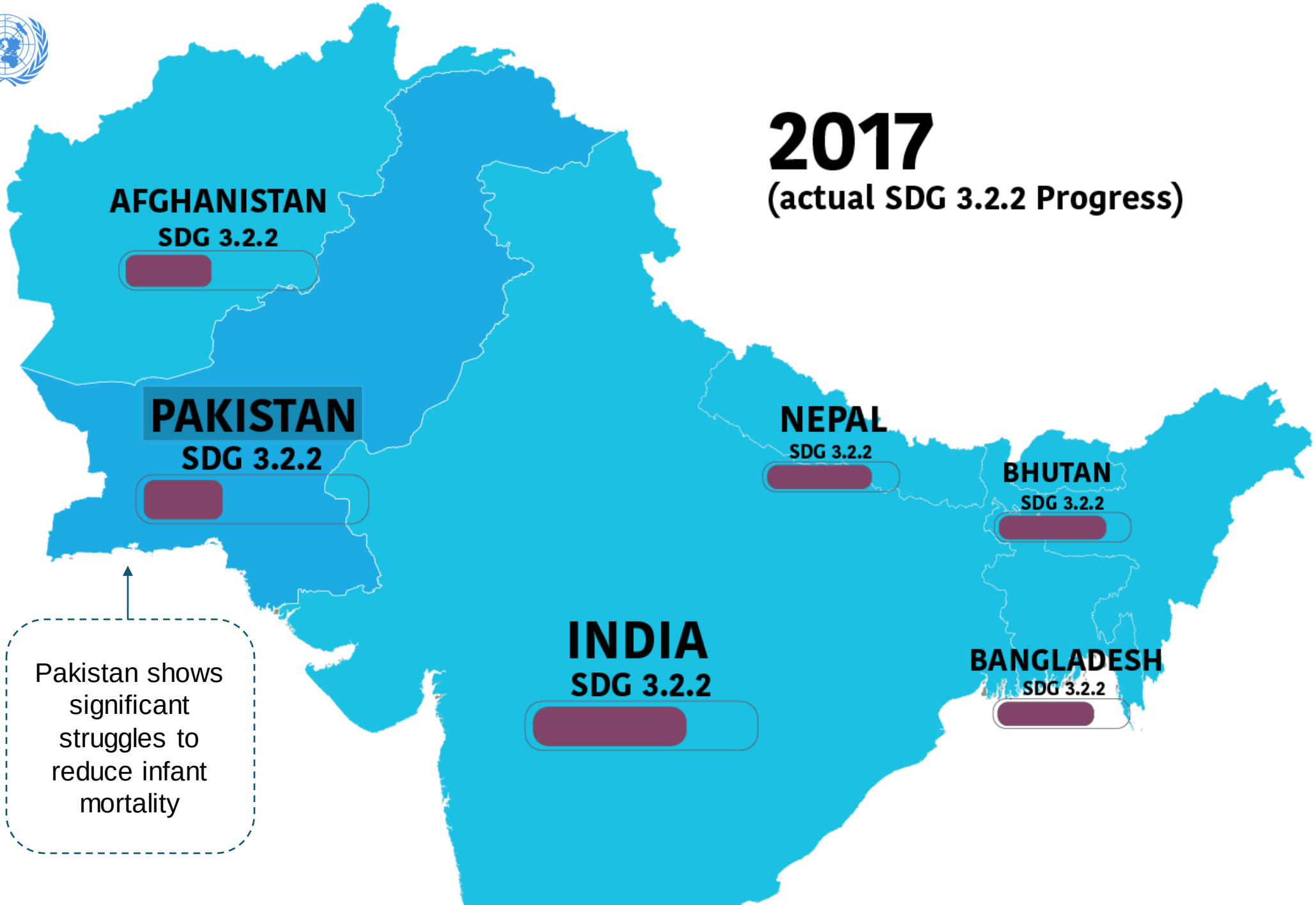
Rafay S. Julia L. Matthew A. Komal S. Sami E.

Problem Statement





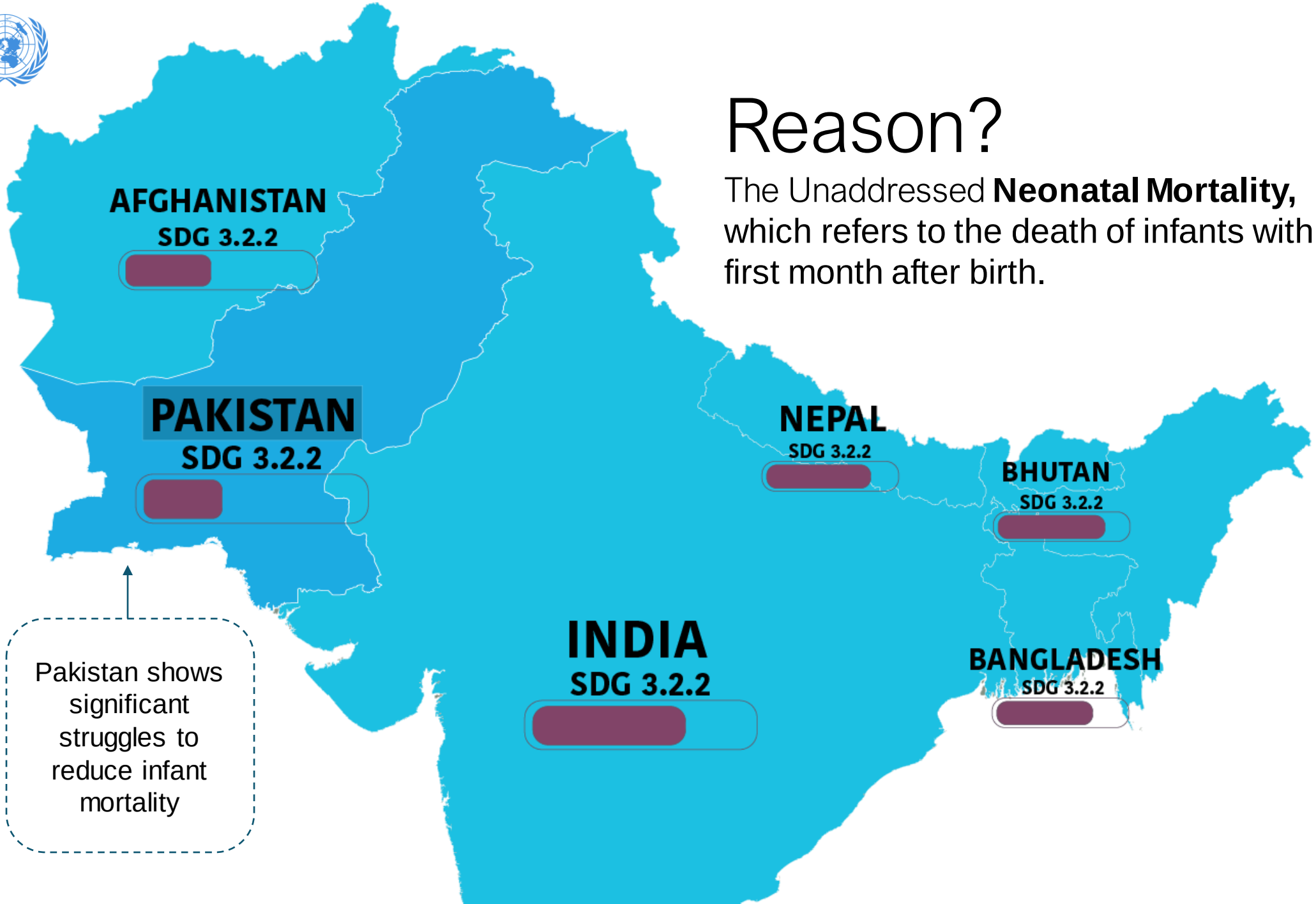




Pakistan shows significant struggles to reduce infant mortality

Reason?

The Unaddressed **Neonatal Mortality,** which refers to the death of infants within their first month after birth.



Pakistan shows significant struggles to reduce infant mortality

Majority of Neonatal Deaths in Pakistan are Caused by Unsterilized Equipment

Reason?

The Unaddressed Neonatal Mortality

Death within **first month** (neonatal stage)

Death within **other 11 months**

Majority of Neonatal Deaths in Pakistan are Caused by Unsterilized Equipment

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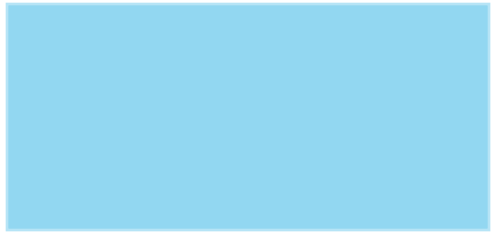
The Unaddressed Neonatal Mortality

Infants are 3x more likely to die within the first month than in the remaining 11 months



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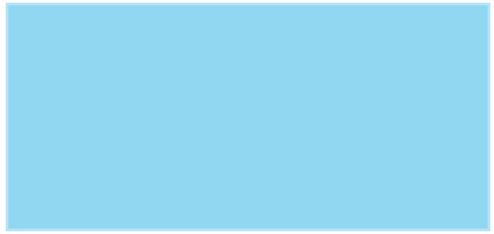

Death within **first month** (neonatal stage)

Death within **other 11 months**

75% of these deaths occur within the first week of life

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
						

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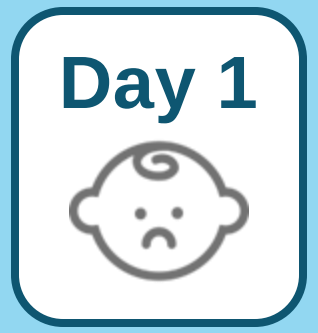


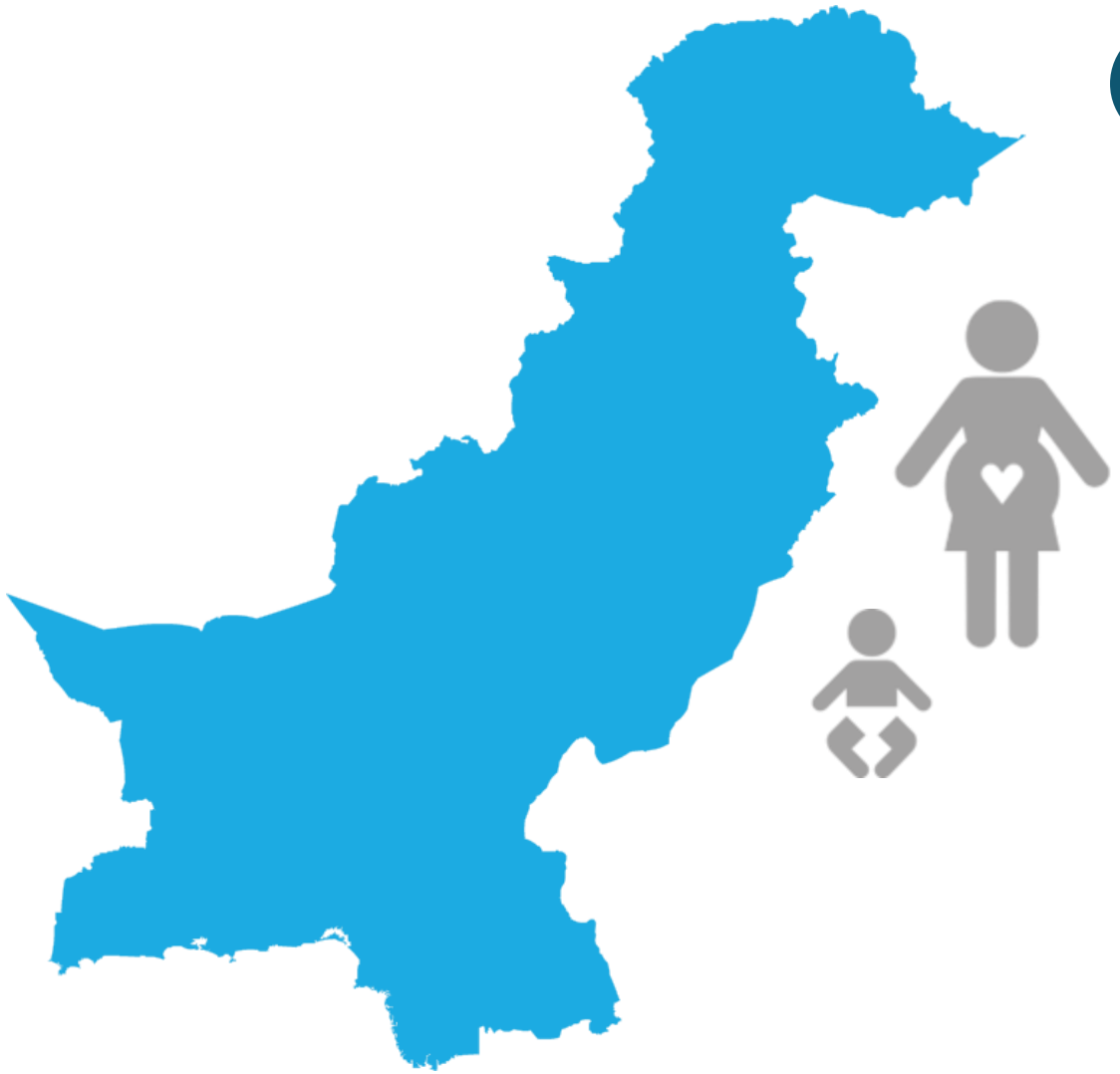
AND **25%** of these deaths occur within 24 hours

These statistics reflect the fact that the majority of these deaths arise due to birth complications being caused by the use of unsterilized equipment when cutting the umbilical cord. This leads to **omphalitis** – an infection of the umbilical cord with a case fatality rate of around 10%.

But Why Is This Important?

The Significance of neonatal mortality arises from its implications for the wider society

Analysis



1 High Fertility Rates

The Significance of Neonatal Mortality Arises From its Implications for the Wider Society

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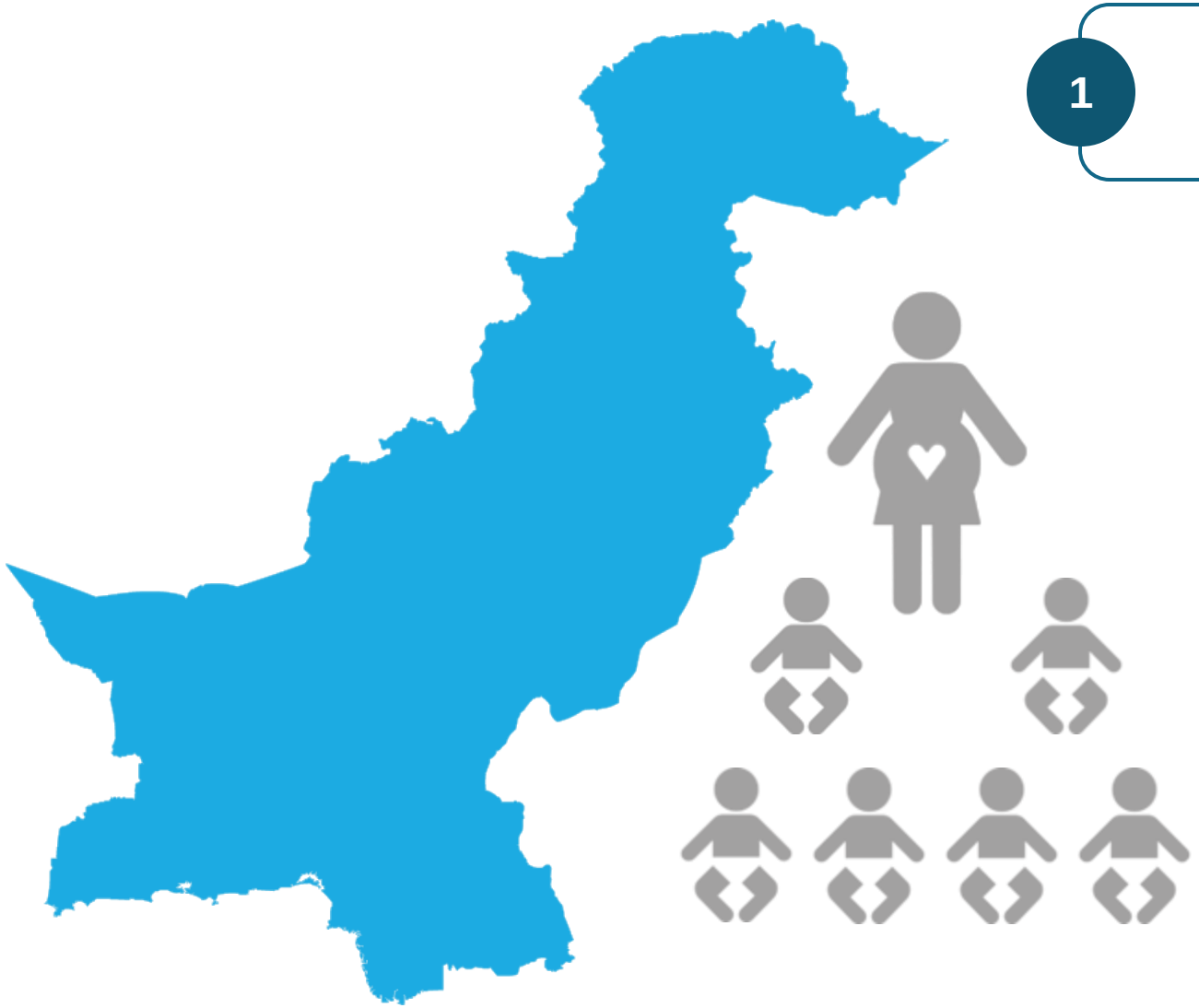

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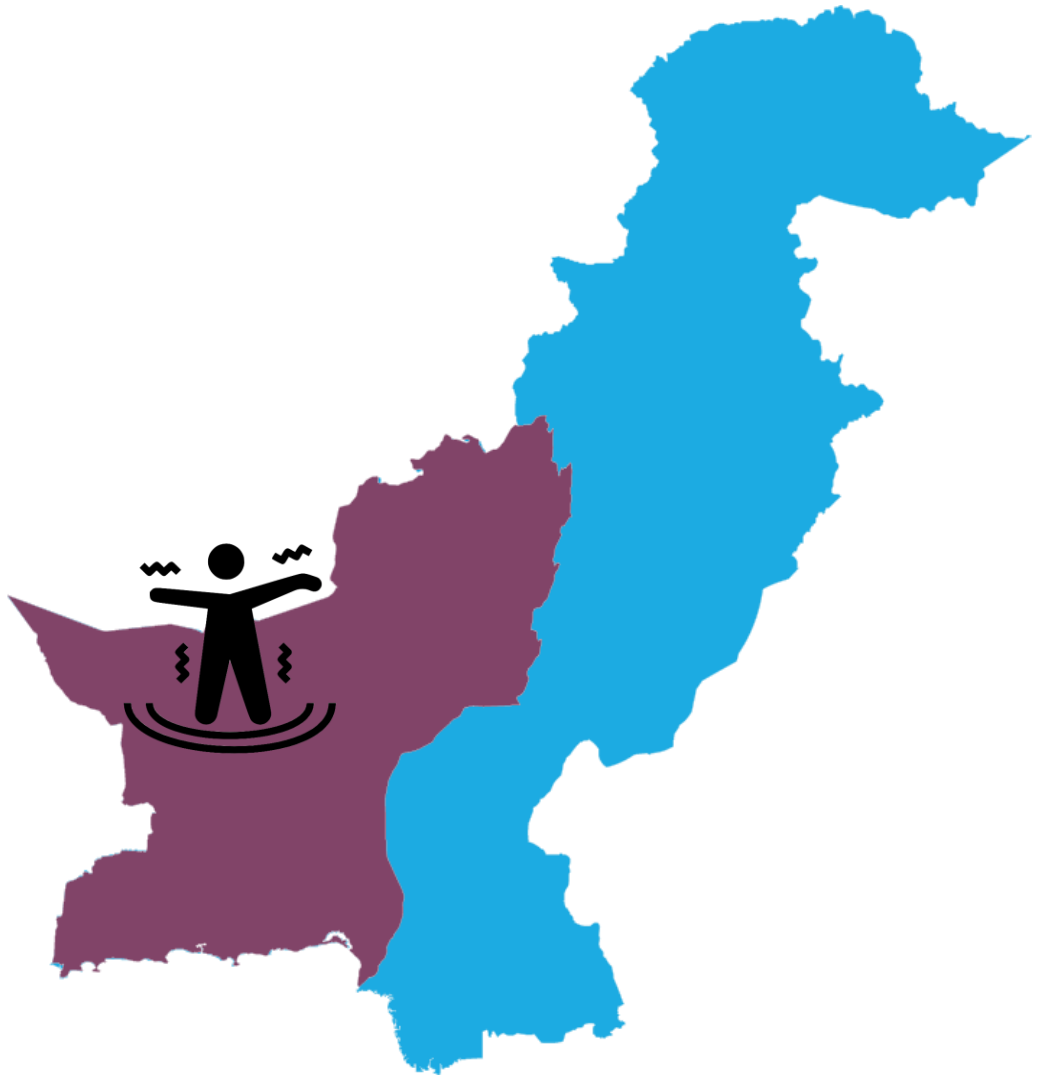

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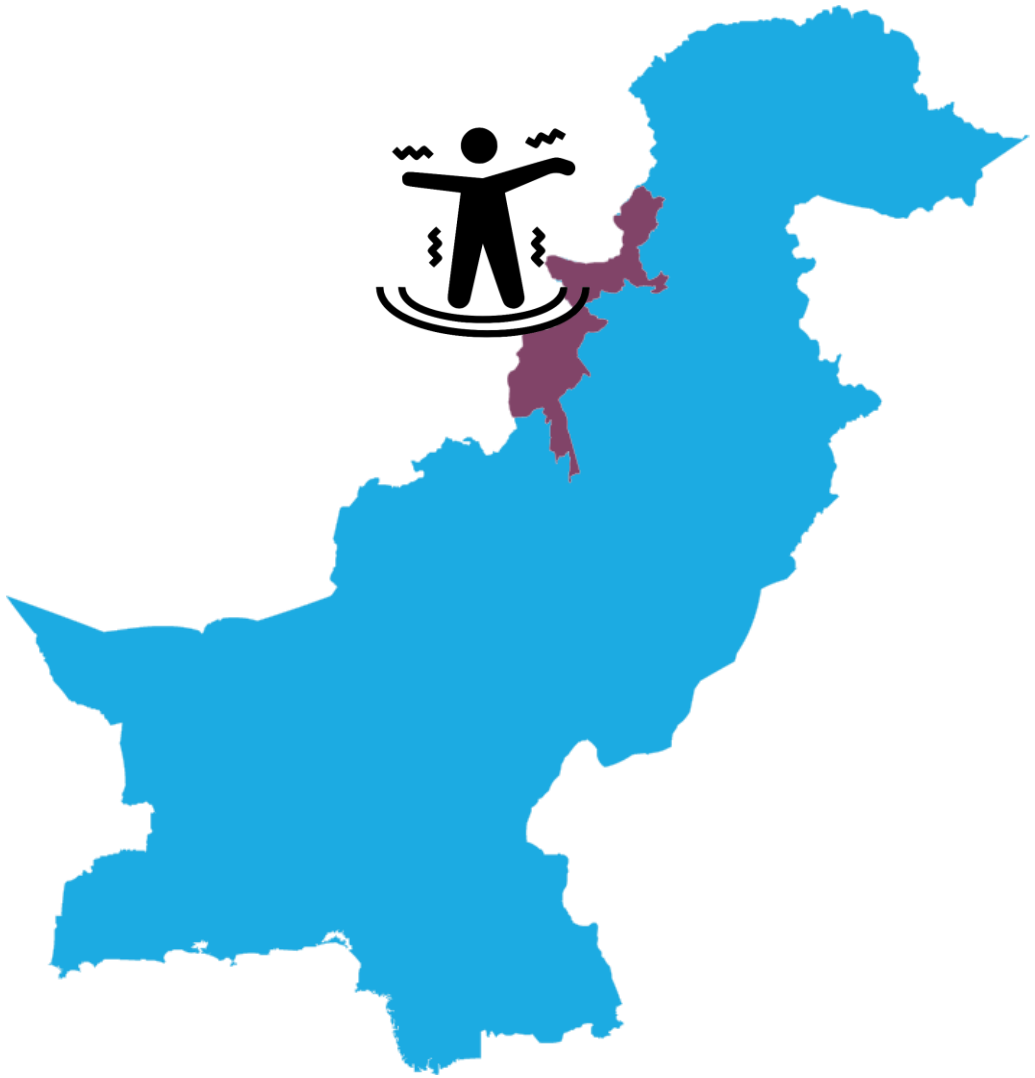

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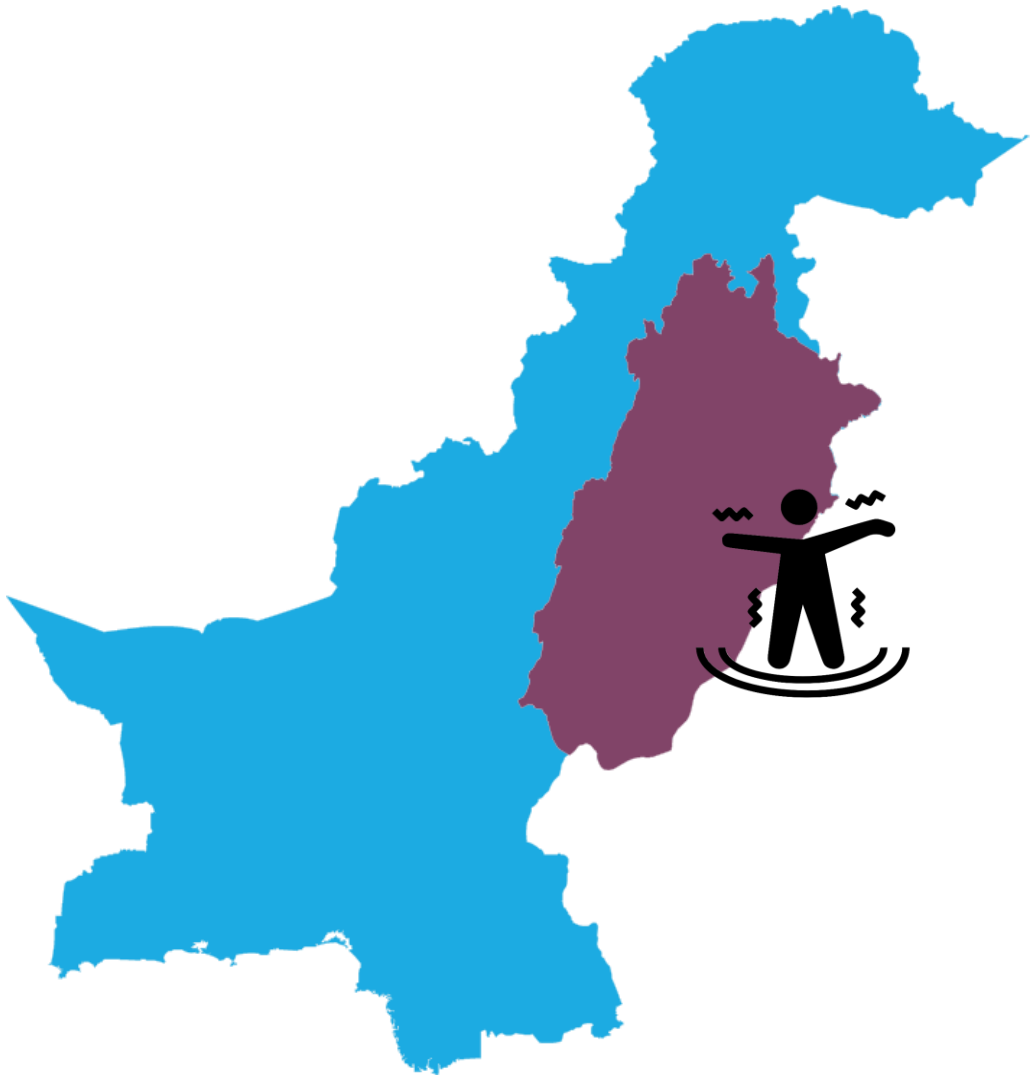

1. High Fertility Rates

2. Regional Political Stability

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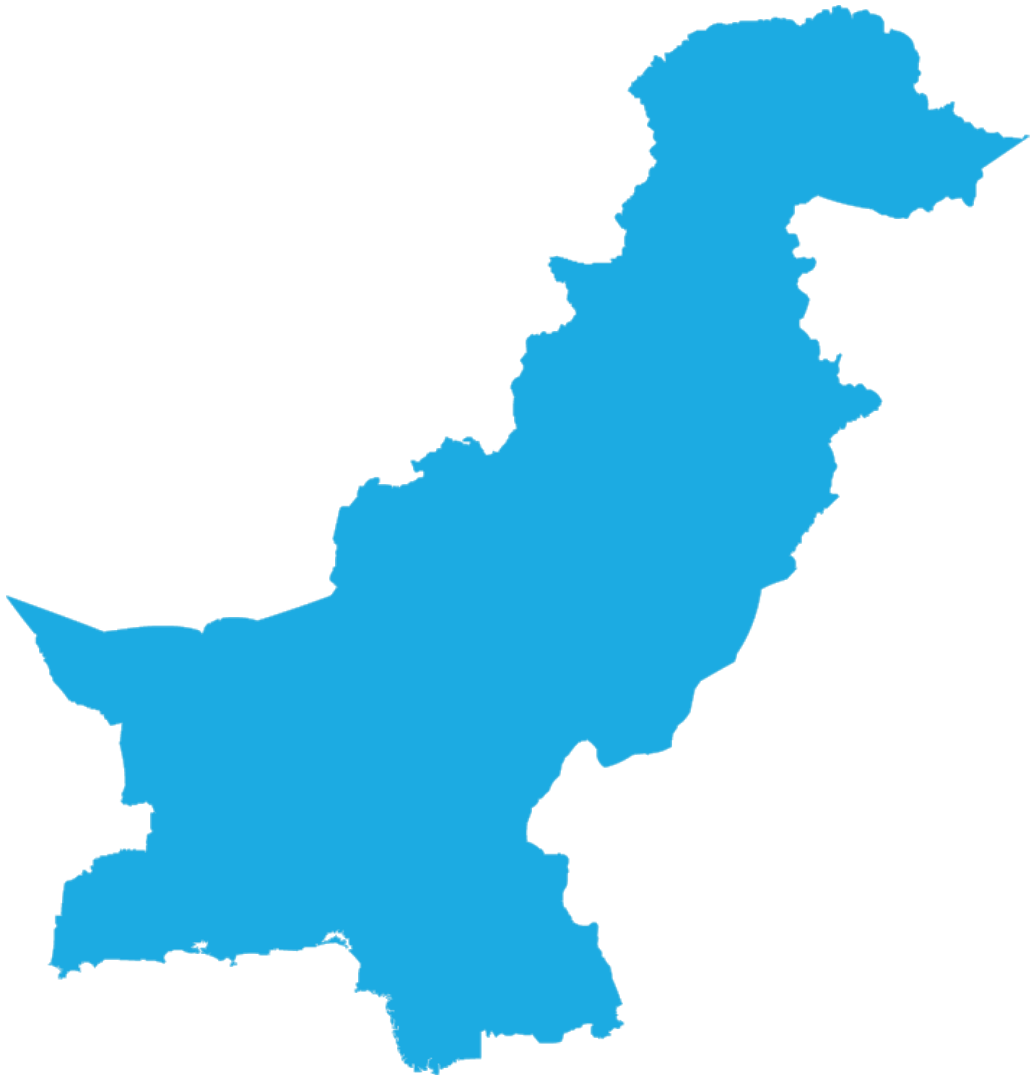

1. High Fertility Rates
2. Regional Political Stability
3. Death of innocent babies

The Significance of Neonatal Mortality Arises From its Implications for the Wider Society

Analysis

1. High Fertility rates
2. Regional Political Instability
3. Death of innocent babies

Addressing the causes of neonatal mortality is therefore crucially important to ensure sustainable development for Pakistan's future as a whole.

The Causes of Meonatal mortality are not mutually exclusive

Immediate Causes of the Problem

Cause 1:
Complications at Birth

Cause 2:
Poor antenatal care

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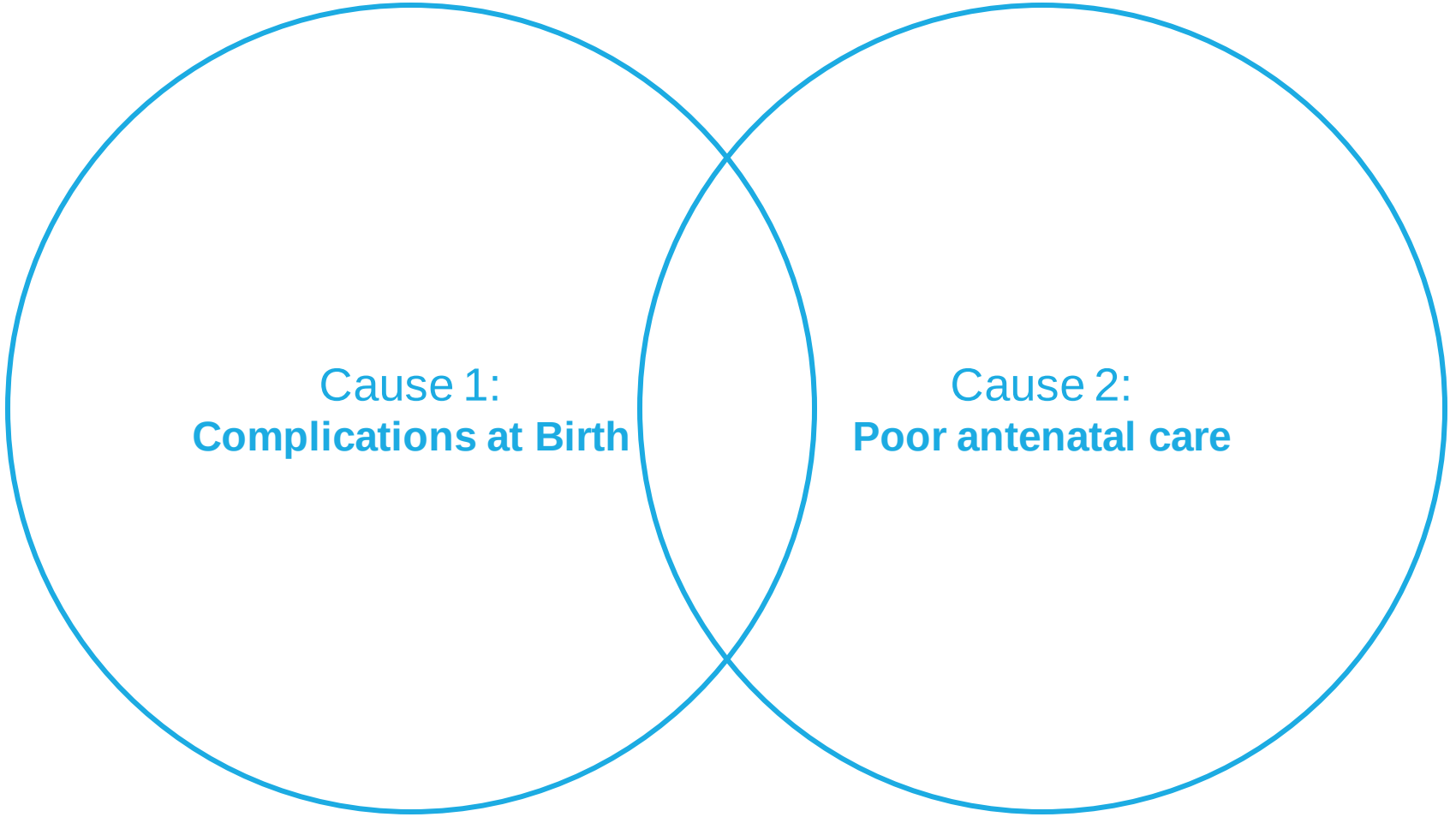

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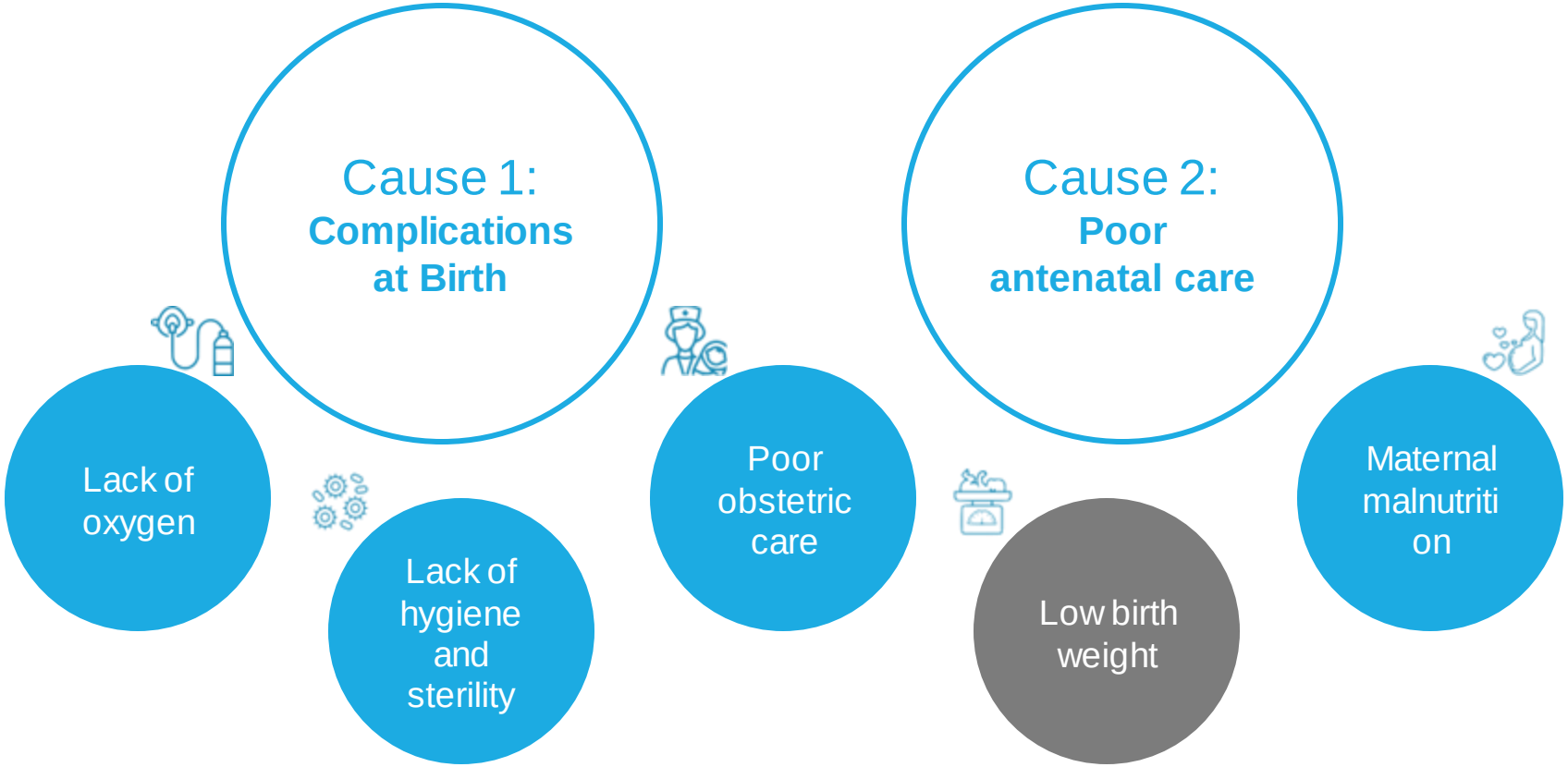

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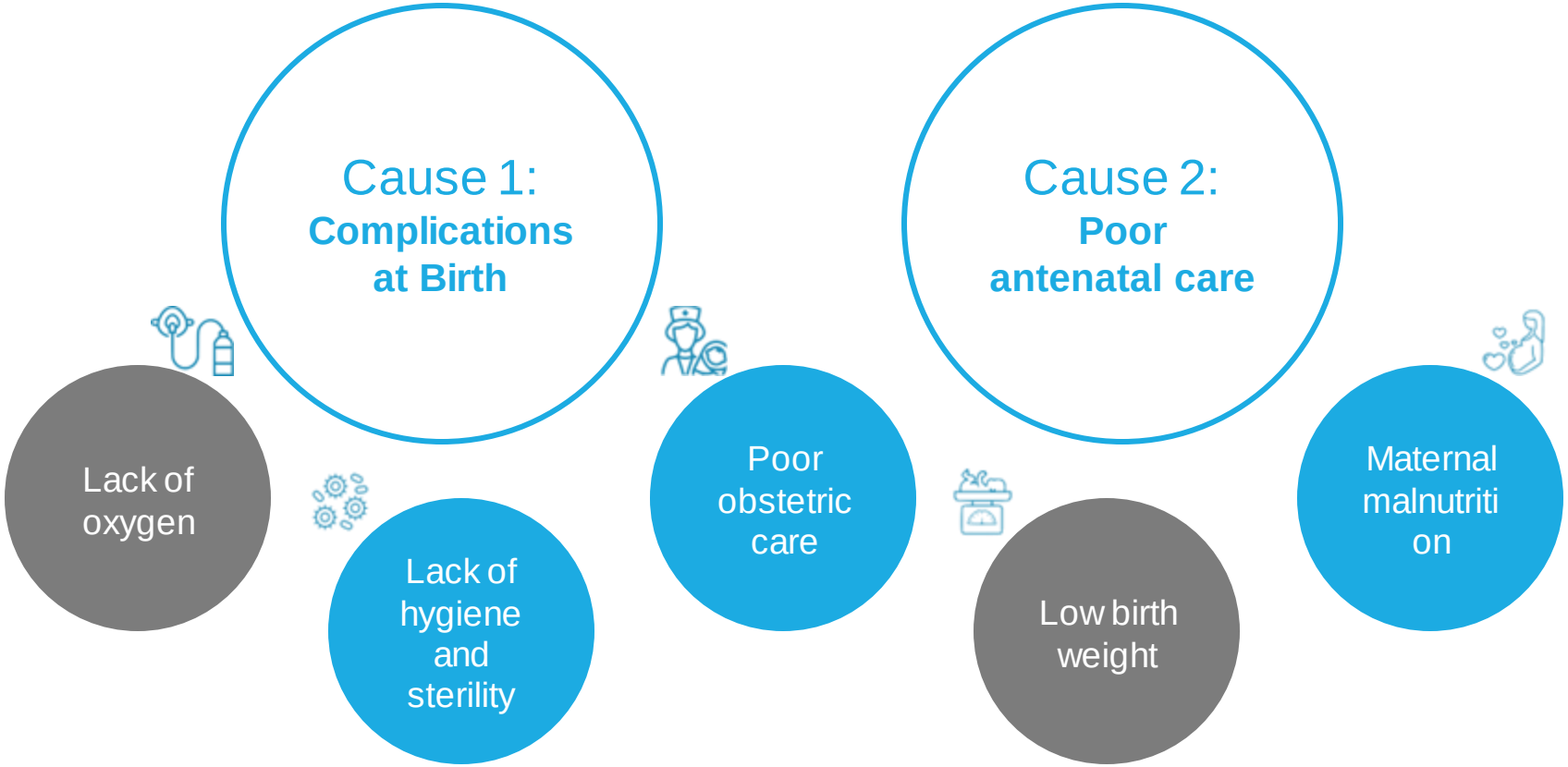

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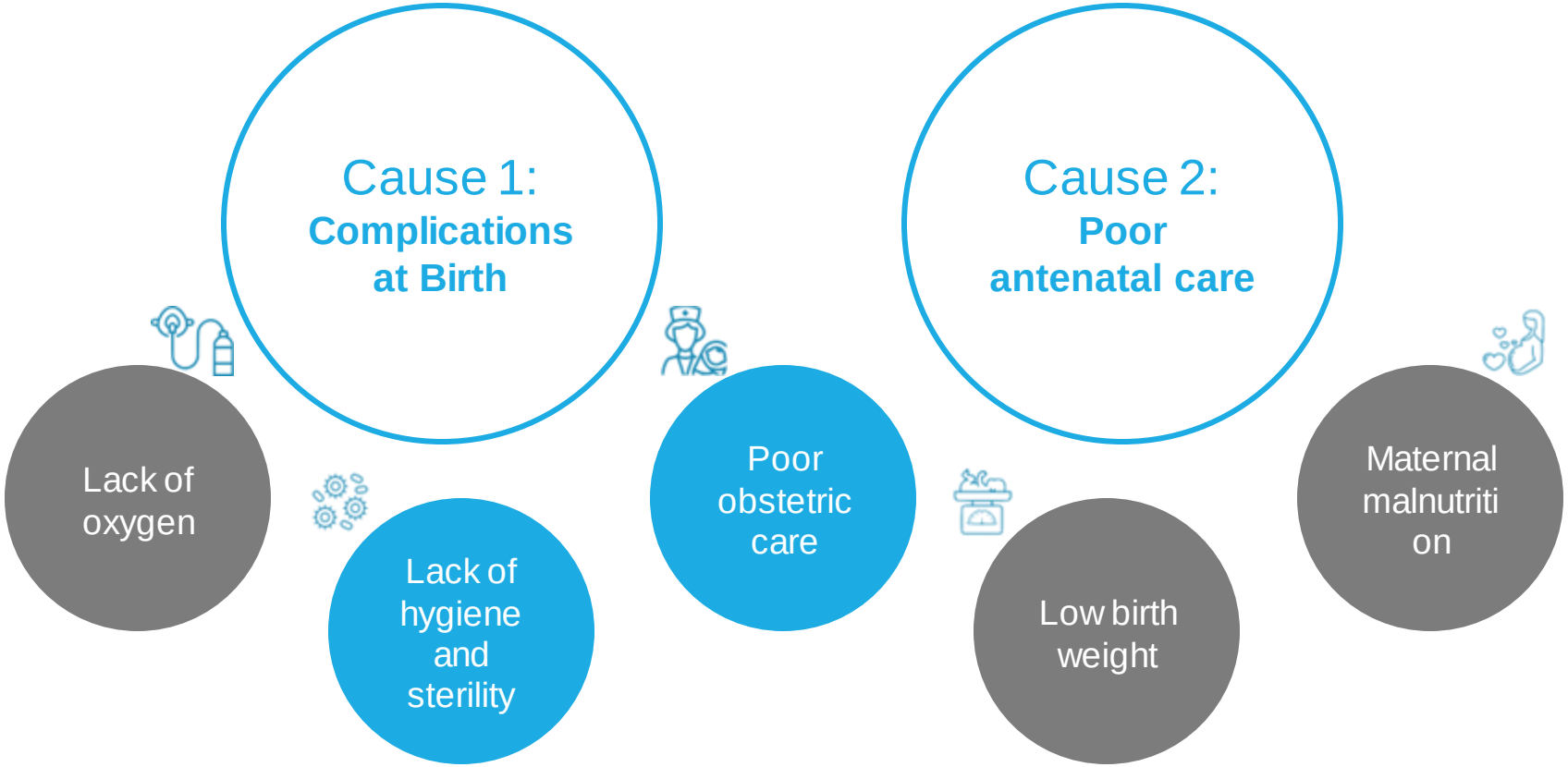

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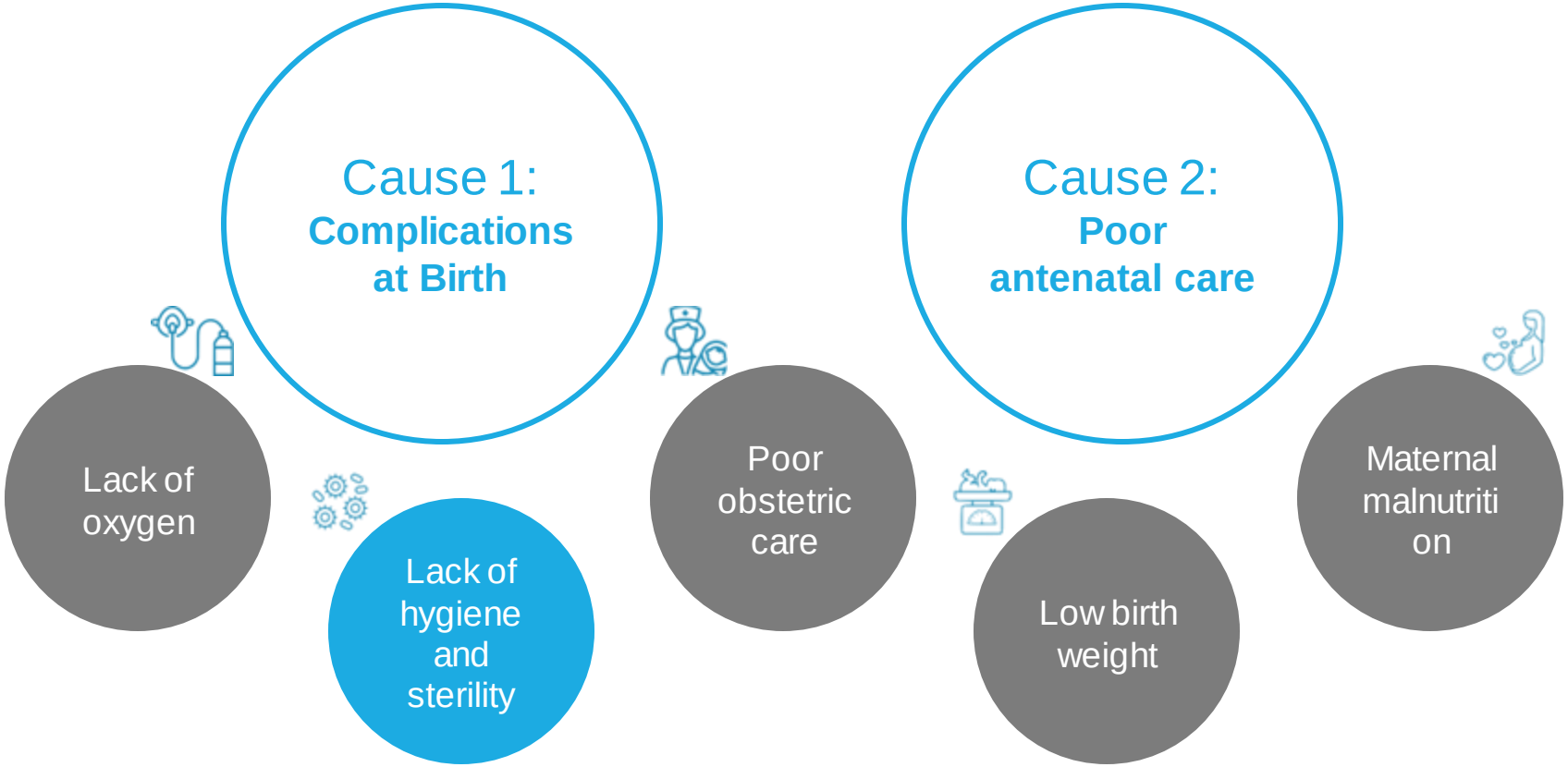

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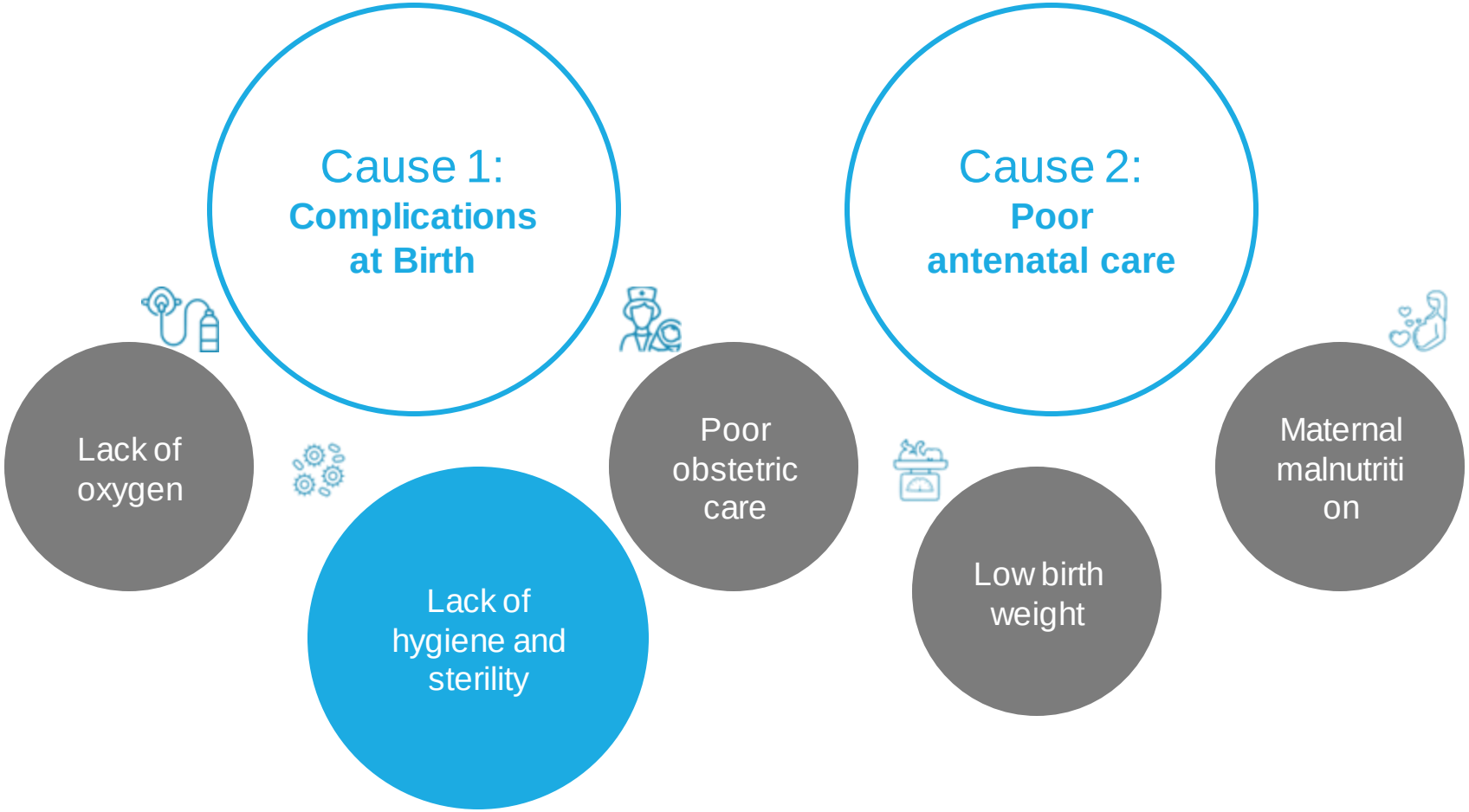

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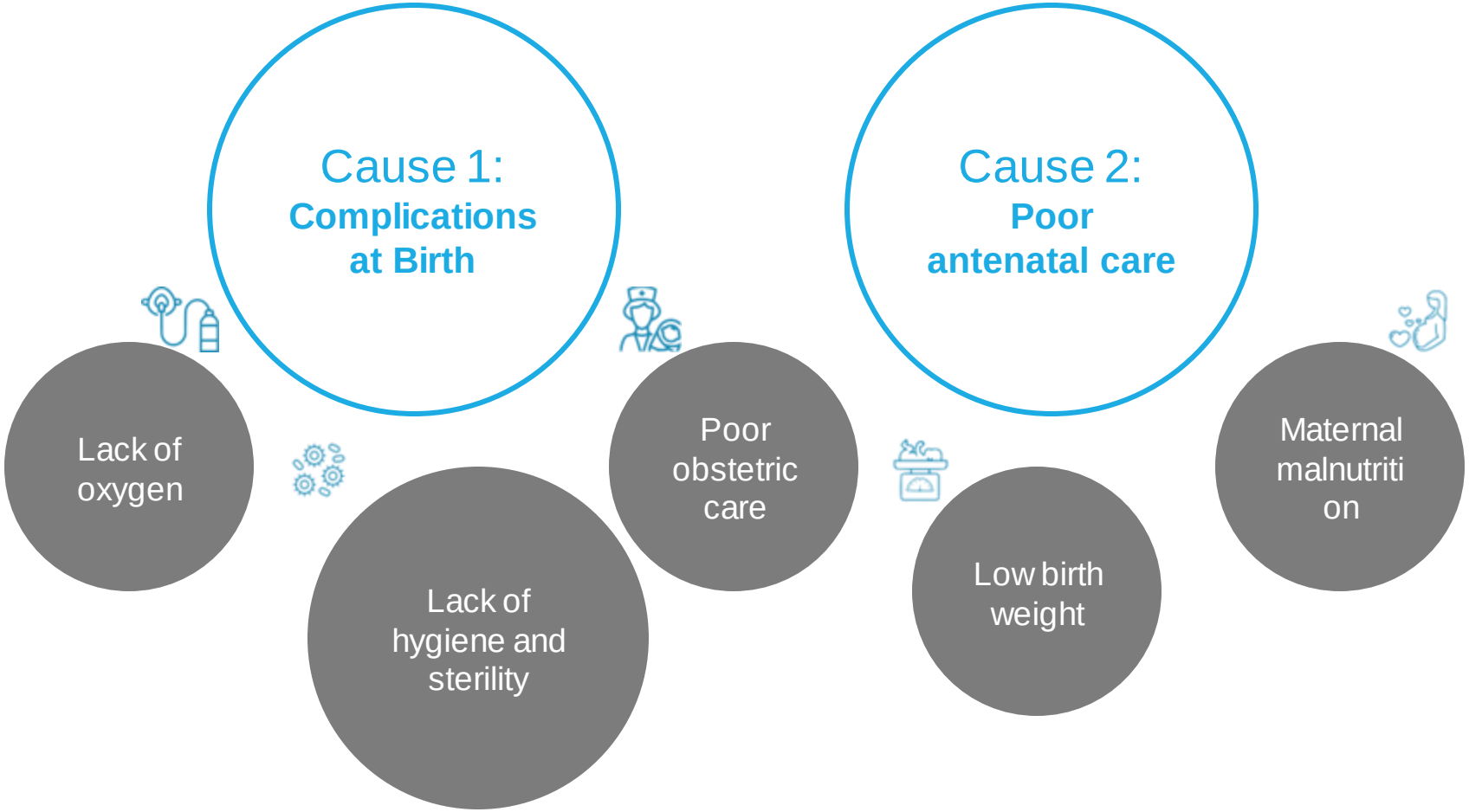

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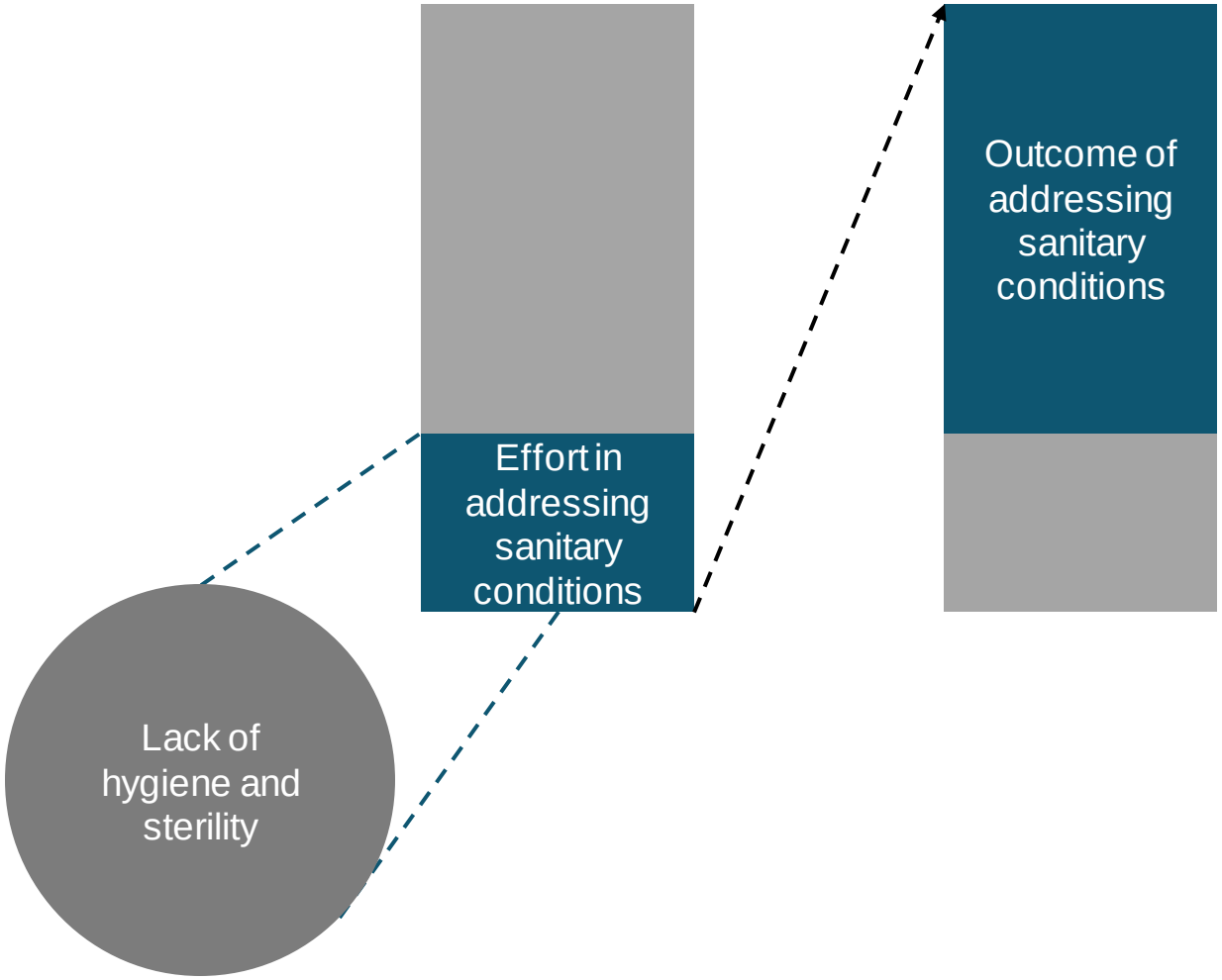


The Causes of Neonatal Mortality are not Mutually Exclusive

Immediate Causes of the Problem

Given all these structural problems and that unsterilized equipment is the most impactful contributor to neonatal mortality, how are we going to address the problem?

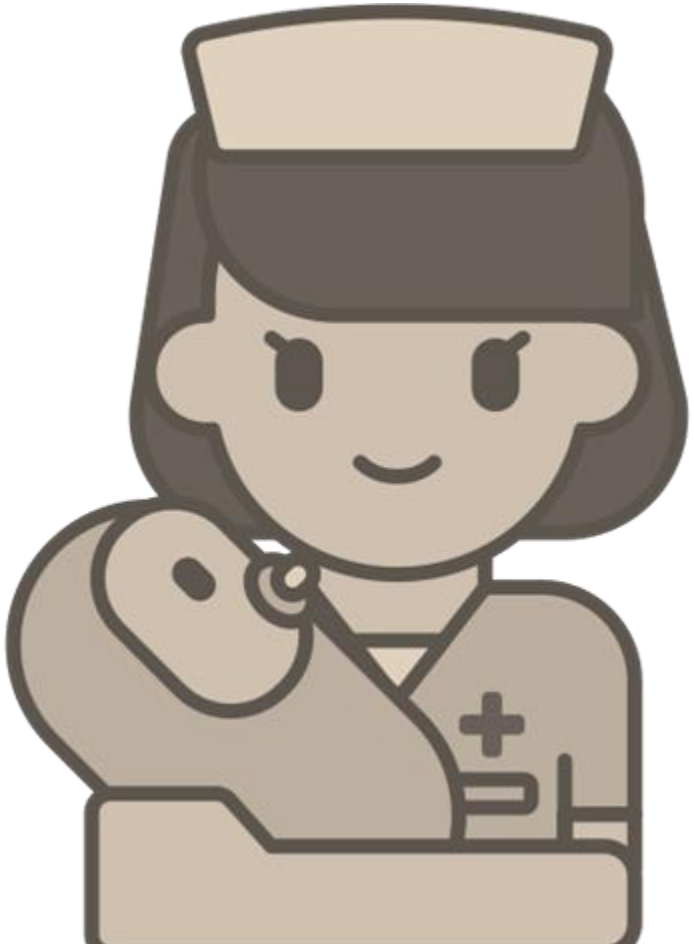
Introducing

Project S.O.S

A solar powered autoclave to sterilize medical equipment for birth delivery.

Meet Azra.

A traditional birth attendant operating near the outskirts of Lahore, Pakistan.



What The Solution will look like from the perspective of the Target User

User Journey

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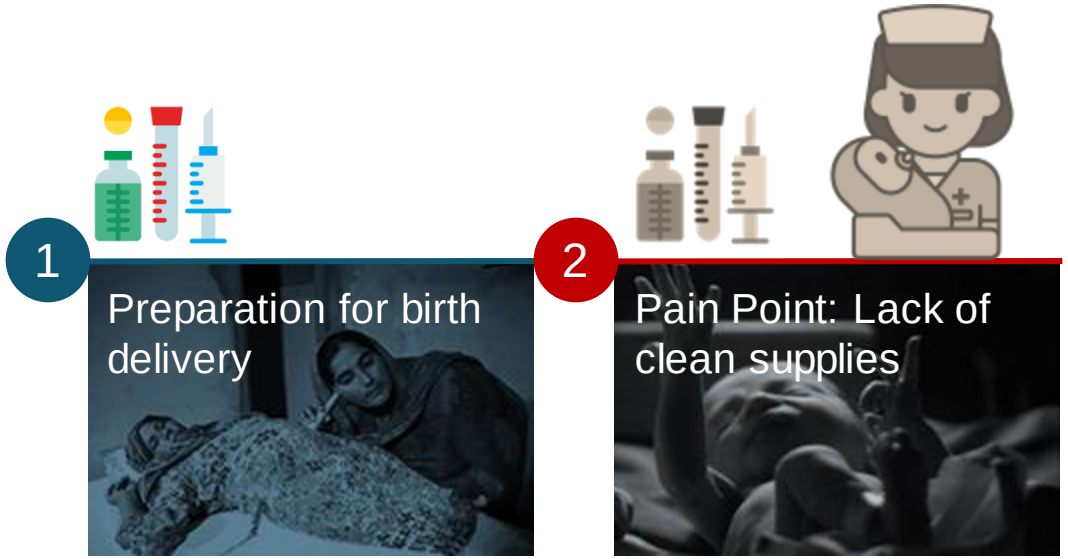


What The Solution Will Look Like From the Perspective of The Target User

User Journey

1

2

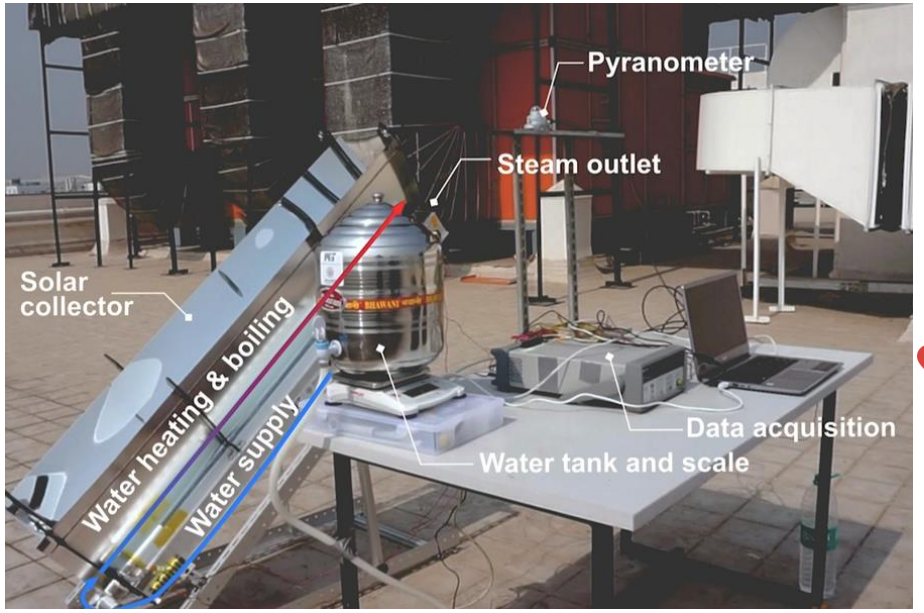
3

The Solar-Powered Autoclave

How it Works

1

Azra puts her tools inside the solar-powered autoclave



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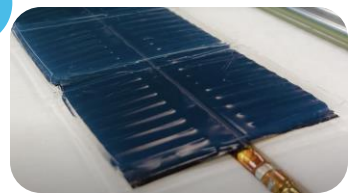
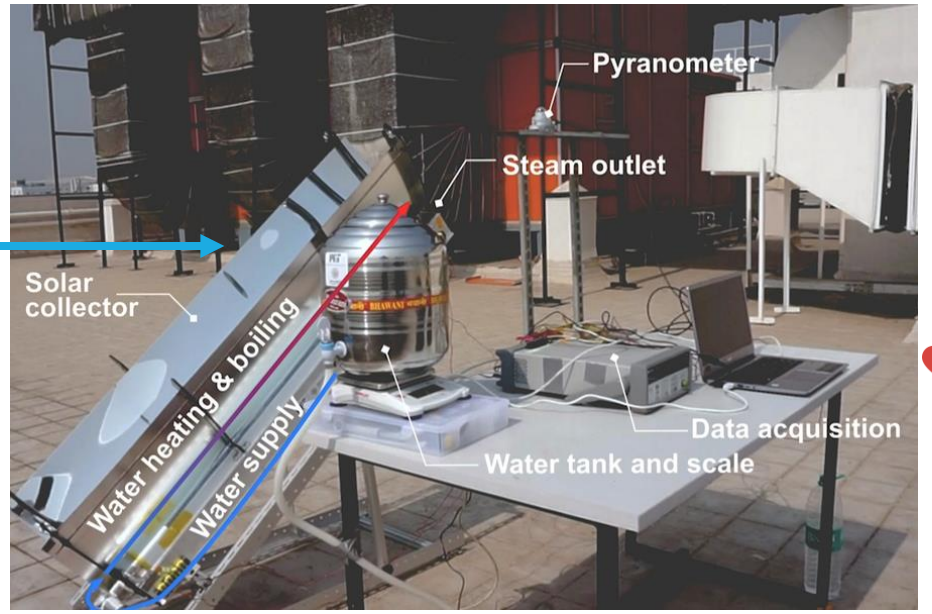
2. 

   The autoclave contains optically transparent aerogel that provides effective thermal insulation, reducing the rate of heat loss by tenfold



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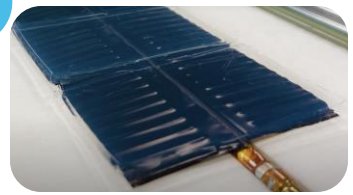
2. 

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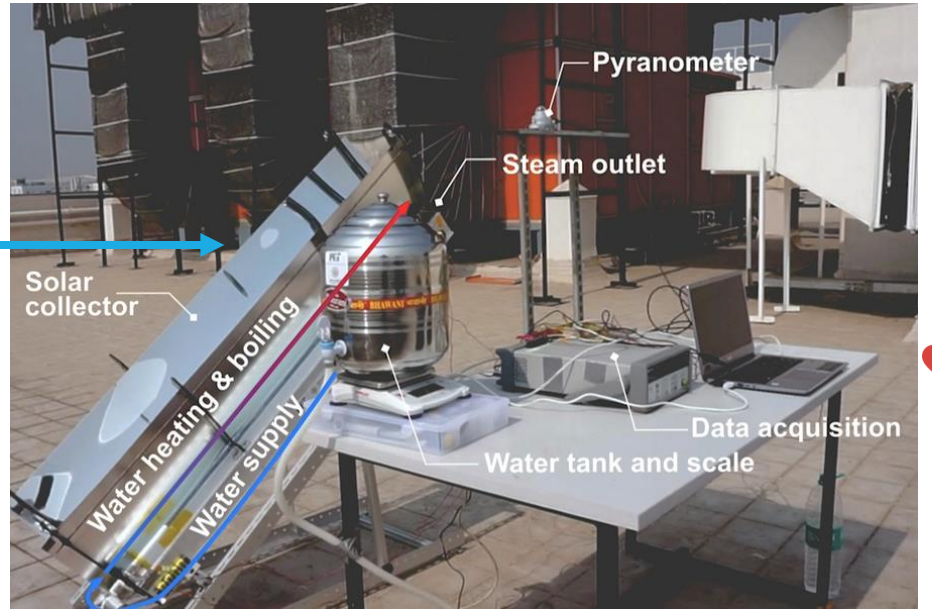
   The aerogel is bonded to the solar collector, which consists of a copper plate with a heat absorbing black coating, bonded to a set of pipes on its underside



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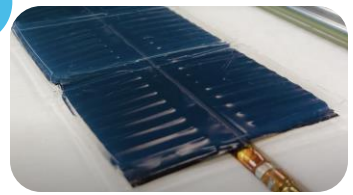
2. 

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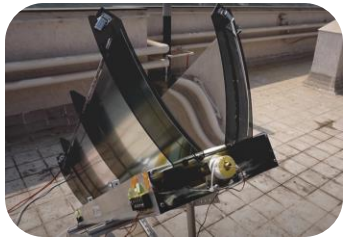
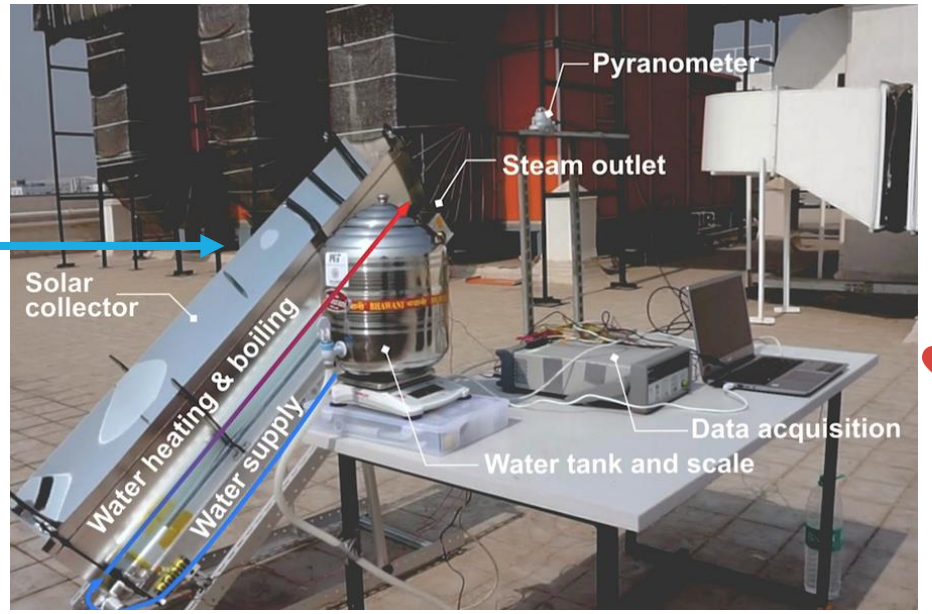
4. 

   As the sun heats the plate, water flowing through the pipes underneath picks up the heat. With the insulating layer on top, plus polished aluminium mirrors to direct extra sunlight, the system generates high temperature steam



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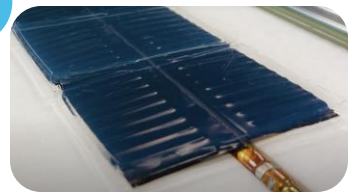
2. 

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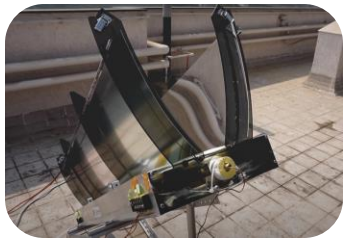
4. 

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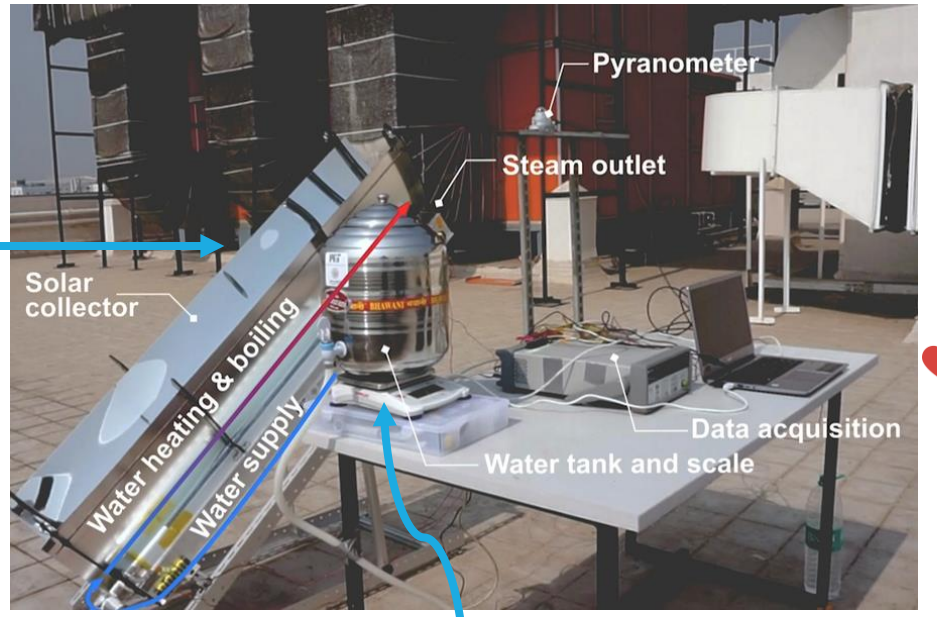
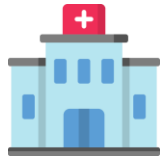


5. Using gravity to feed water from a tank into the plate, steam rises to the top of the enclosure and is fed out through another pipe, which carries the steam to the autoclave.

What The Solution Will Look Like From the Perspective of The Target User

User Journey

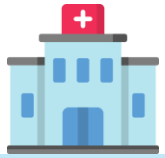
Azra has faith in the solar-powered autoclave as it has been widely tested, such as in Mumbai, where it was proven to function successfully even on cloudy days.



Key Stakeholders

The Intervention Will Require the Onboarding of Key Stakeholders

Major Stakeholders



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Charity led hospital

Provide high-quality health care to the underprivileged in Punjab

Essential in our plan of action to implement the autoclave

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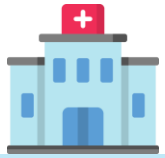

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Will also be in charge of monthly maintenance of the device

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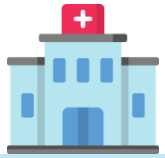

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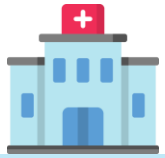

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Midwives and Traditional B.A

Individuals that **carry out our intervention** and use the device

Need to be educated on how to use the device

Will be the primary source to create awareness of the device organically

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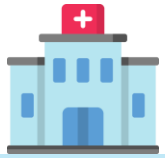

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Healthcare Departments

Responsible for delivering **healthcare services across Lahore**

Require approval and funding

In contact with Muhammad Usman Younis, the Secretary

Implementation

We’ve planned 6 steps for success

How Can We Implement This Solution?

Theory of Change and Implementation

From Idea to Impact

May	June	July	August	September	October
	Build and Install Autoclave				

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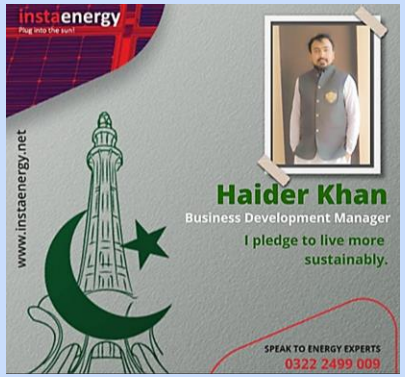
Build and Install Autoclave

Receive Quote from InstaEnergy

Expected Quote:
$300 - $400 CAD



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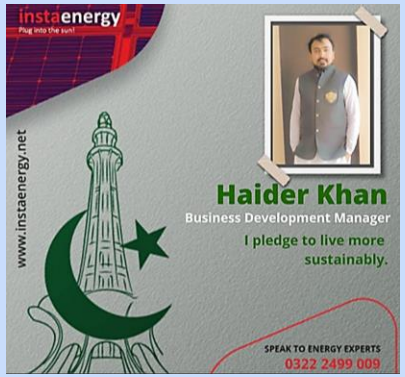
Determine Target Location with Medicare Health Foundation

Expected Quote:
$300 - $400 CAD



How Can We Implement This Solution?

Theory of Change and Implementation

From Idea to Impact

May	June	July	August	September	October

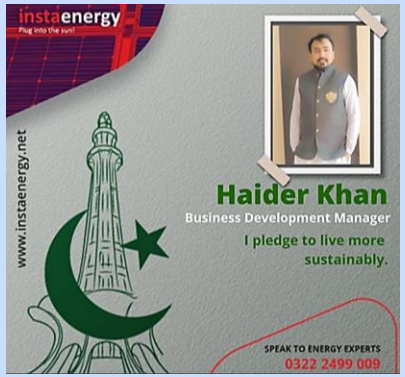
Receive Quote from InstaEnergy

Build and Install Autoclave

Determine Target Location with Medicare Health Foundation

Shipping and assemble on-site

Expected Quote:
$300 - $400 CAD



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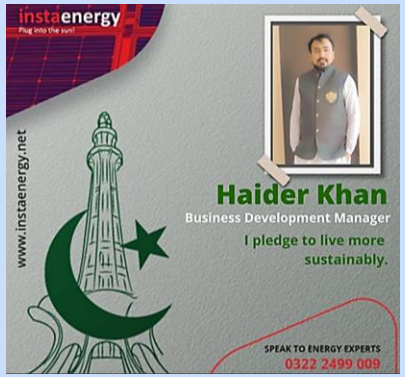


Dr. Anam Qadri, Director for Research and Projects at Medicare

How Can We Implement This Solution?

Theory of Change and Implementation

From Idea to Impact

May	June	July	August	September	October

Receive Quote from InstaEnergy

Build and Install Autoclave

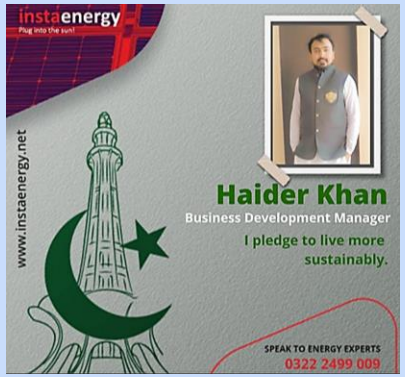
Determine Target Location with Medicare Health Foundation

Shipping and assemble on-site

Form on-site team

Conduct monthly on-site maintenance check-ups

Expected Quote:
$300 - $400 CAD



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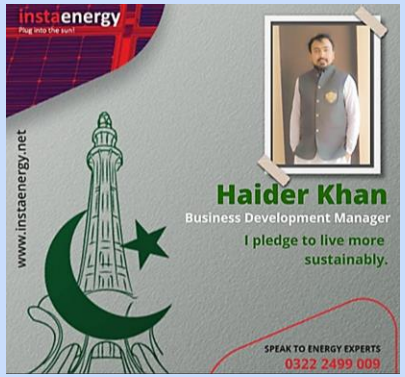


Dr. Anam Qadri, Director for Research and Projects at Medicare

How will we measure our intervention's success in contributing to SDG 3.2.2?

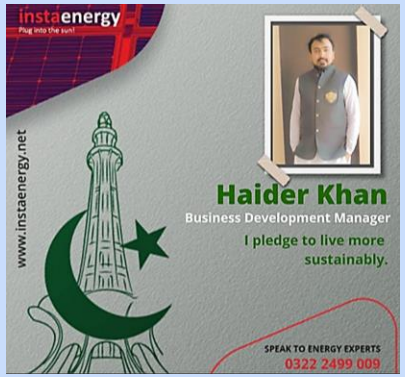
How Can We Implement This Solution?

Theory of Change and Implementation

From Idea to Impact

May	June	July	August	September	October
Receive Quote from InstaEnergy	Build and Install Autoclave	Determine Target Location with Medicare Health Foundation	Shipping and assemble on-site	Form on-site team	Conduct monthly on-site maintenance check-ups
					Collect, Compare, and Report Data

Expected Quote:
$300 - $400 CAD



Dr. Anam Qadri, Director for Research and Projects at Medicare

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How Can We Implement This Solution?

Theory of Change and Implementation

Long-Term Plan

2021+

How Can We Implement This Solution?

Theory of Change and Implementation

Long-Term Plan

2021+

How can we make the intervention sustainable and scalable?

→ Collaboration with Local Universities in Pakistan to organize a **competition for building solar-powered autoclaves**

How Can We Implement This Solution?

Theory of Change and Implementation

Long-Term Plan

2021+

How can we make the intervention sustainable and scalable?

Collaboration with Local Universities in Pakistan to organize a **competition for building solar-powered autoclaves**

Dr. Shabina Ariff

Dr. Sajid Soofi

Aga Khan University

Dept. of Pediatrics and Child Health

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1 Build Autoclave

2 Self-Fund

3 Submit Design

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Dr. Sajid Soofi

Aga Khan University

Dept. of Pediatrics and Child Health

1 Build Autoclave

2 Self-Fund

3 Submit Design

The humanitarian cause and real-world engineering experience is a major incentive for students to build solar-powered autoclaves sustainably and for minimal cost for communities in need

Financial Implications

The autoclave will be implemented over 6 months and requires few upfront costs

Implementation Timeline and Financial Costs

Build-up and logic of financials

Autoclave Device Costs ($350)

Cost of Aerogel + Other materials required + Container for sterilized equipment

Implementation and Maintenance

Shipping Costs + Labor and Maintenance

The autoclave will be implemented over 6 months and requires few upfront costs

Implementation Timeline and Financial Costs

Build-up and logic of financials

Autoclave Device Costs ($350)

Cost of Aerogel + Other materials required + Container for sterilized equipment

Implementation and Maintenance

Shipping Costs + Labor and Maintenance

Total Costs

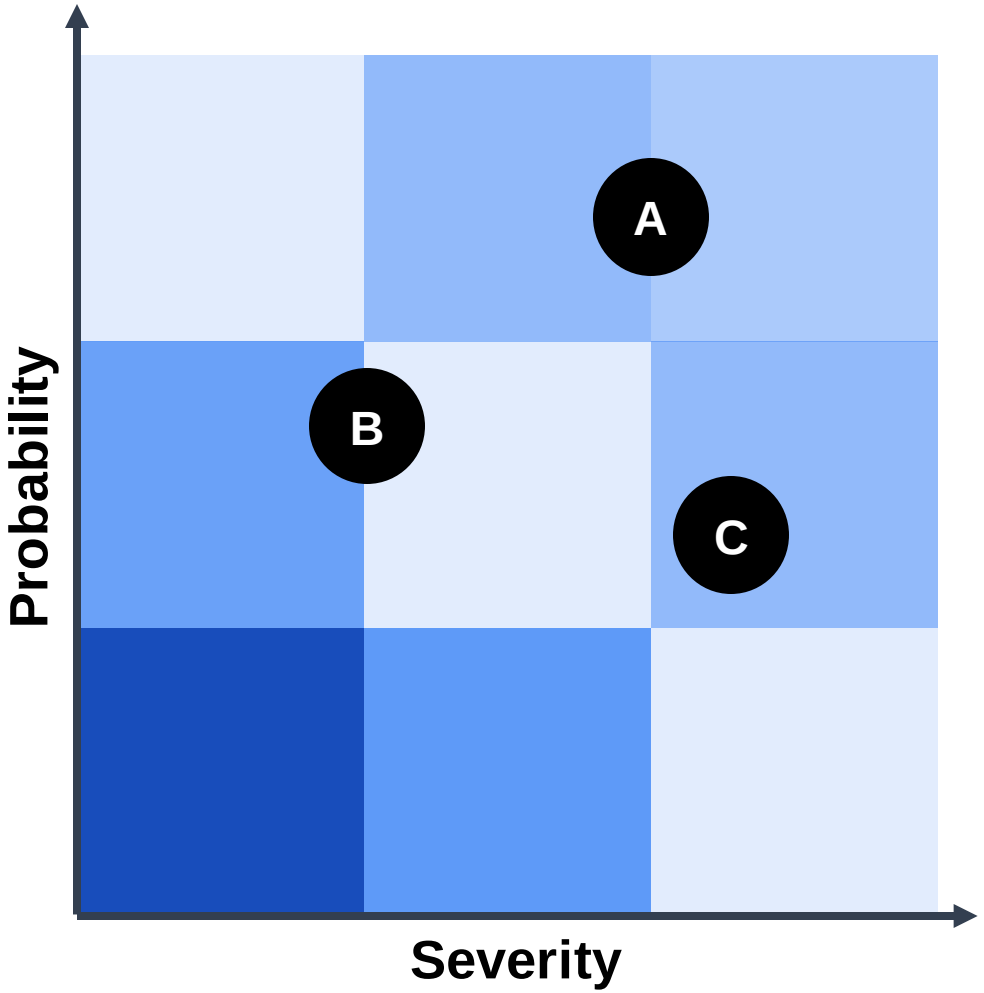
$2,050 initial investment

$950 projections pending

Risks and Mitigations

The intervention poses key risks, but they can be mitigated

Risks and Mitigations



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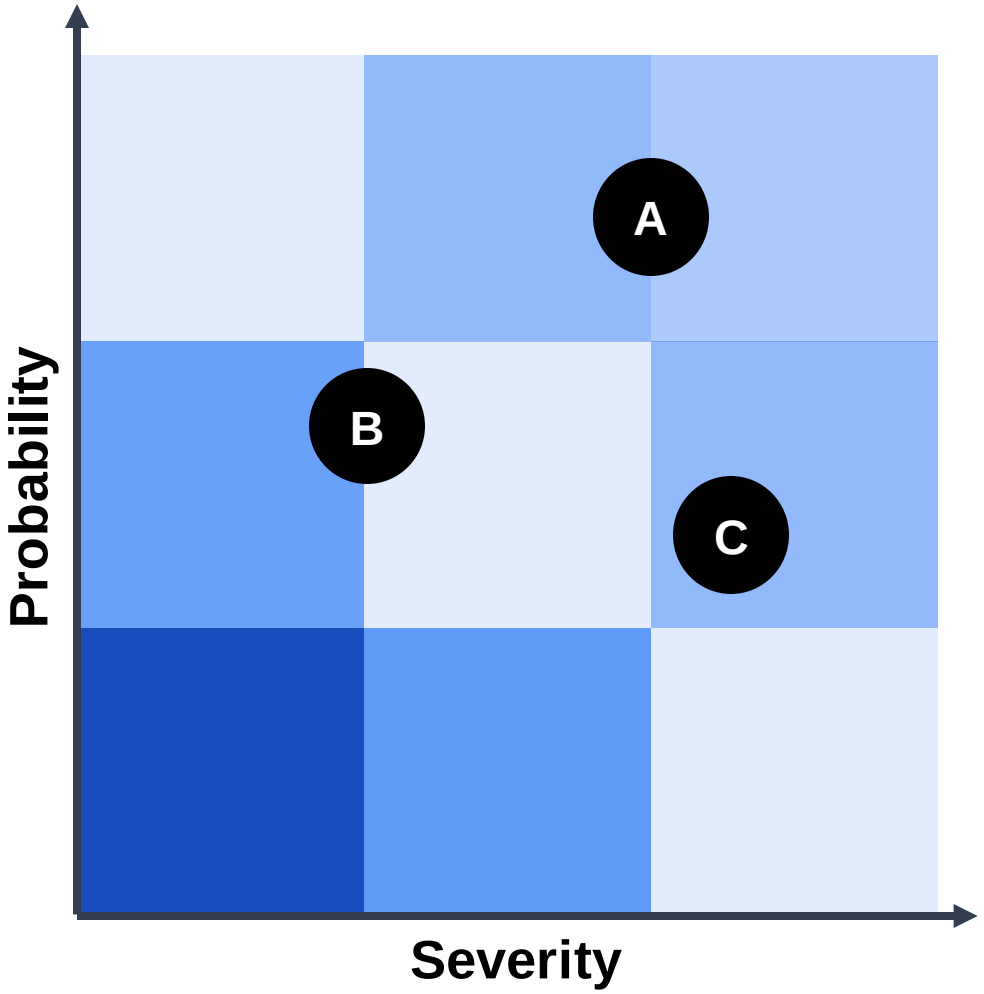
Risks and Mitigations



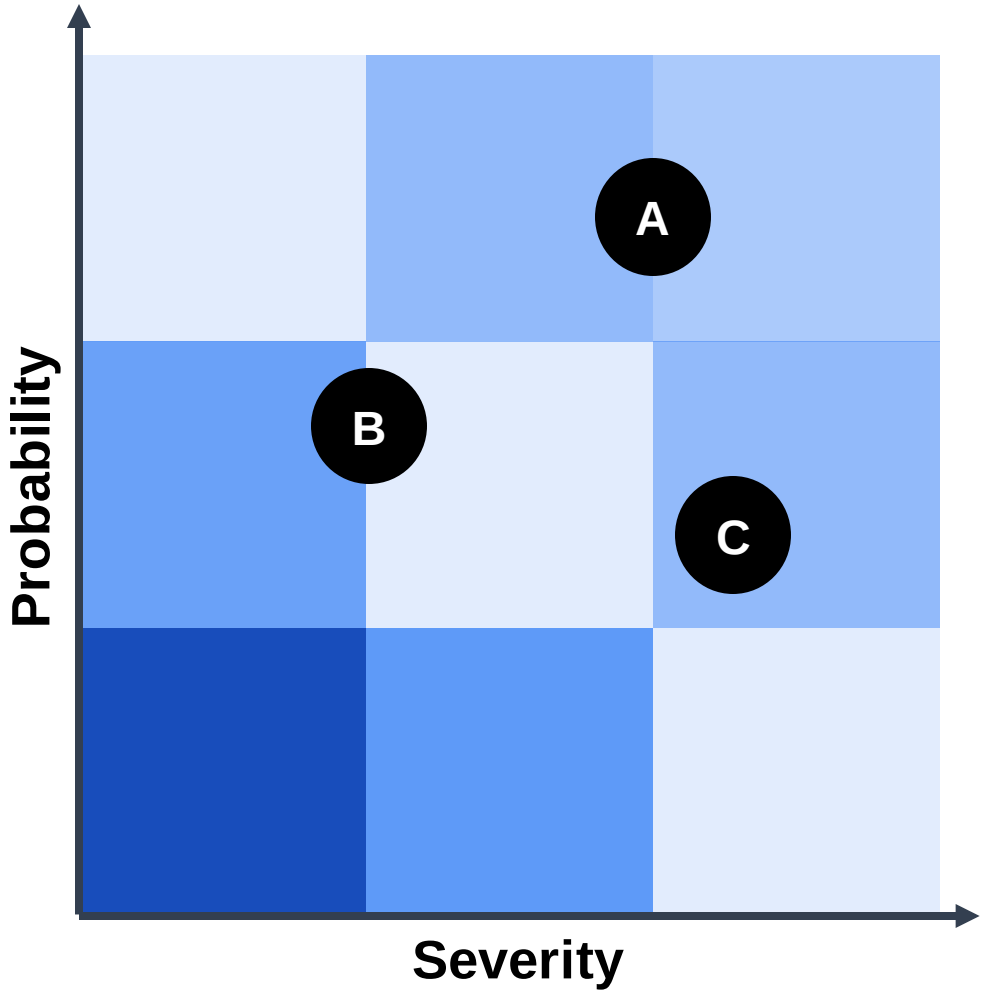
A

Lack of knowledge regarding the culture of distinct rural communities and religious leaders could make it difficult for community members to accept the autoclave.

Need to interact on the ground-level to familiarize ourselves with the community and communicate with locals.

The intervention poses key risks, but they can be mitigated

Risks and Mitigations



A

Lack of knowledge regarding the culture of distinct rural communities and religious leaders could make it difficult for community members to accept the autoclave.

Need to interact on the ground-level to familiarize ourselves with the community and communicate with locals.

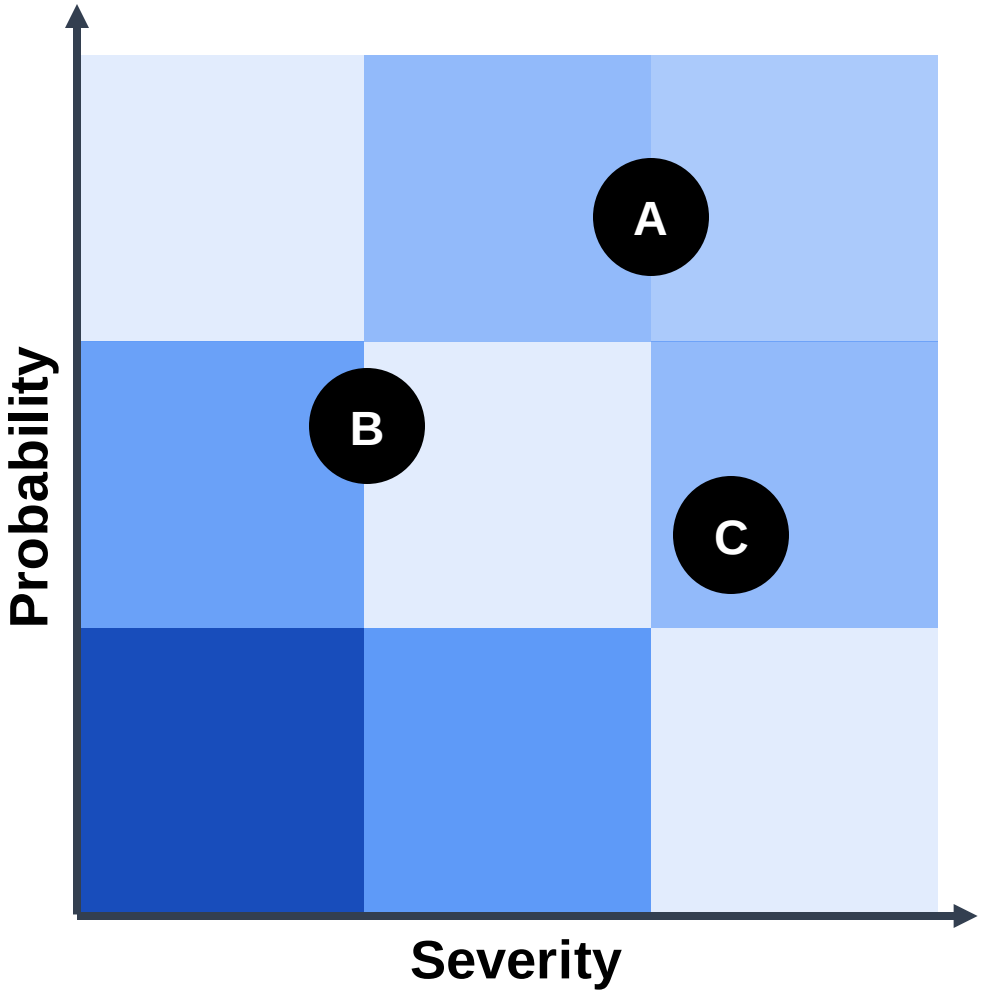
B

The device has the potential to be misused to sterilize other equipment. Furthermore, safeguarding the autoclave would be the biggest threat as crime within the province is high, and parts could be sold in the market.

Install a GPS on the device that can be tracked virtually. Further increase security by adding a proximity sensor and alarm on the device that turns on at night.

The intervention poses key risks, but they can be mitigated

Risks and Mitigations



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B

The device has the potential to be misused to sterilize other equipment. Furthermore, safeguarding the autoclave would be the biggest threat as crime within the province is high, and parts could be sold in the market.

Install a GPS on the device that can be tracked virtually. Further increase security by adding a proximity sensor and alarm on the device that turns on at night.

C

The intervention would require approvals from a variety of intermediaries. Flaws in the design of the device or other issues may prevent us from receiving such approvals.

Before deployment, refine the logistics of the intervention by seeking expertise and working closely with stakeholders. Account for emergency and mistake costs.

What is the Impact?

To revisit our previous pain points…

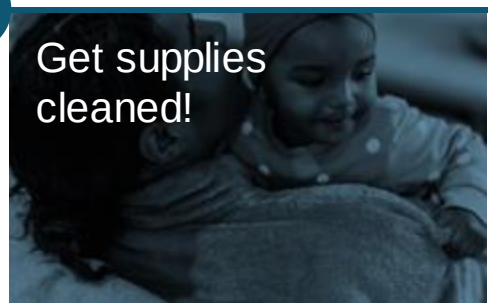
Impacts of the Intervention

1

2

3

4



Our Impacts

Our Impacts

Proper sterilization of equipment

Our Impacts

Proper sterilization of equipment

Eliminated need for electricity & fuel

Our Impacts

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Eliminated need for electricity & fuel

Reduced travel time and workload for birth attendants

Our Impacts

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Our Impacts

Proper sterilization of equipment

Eliminated need for electricity & fuel

Reduced travel time and workload for birth attendants

Reduce risk of developing omphalitis and sepsis

Decrease neonatal mortality rate

Self-sustaining and cost-efficient

Our Impacts

Proper sterilization of equipment

Eliminated need for electricity & fuel

Reduced travel time and workload for birth attendants

Reduce risk of developing omphalitis and sepsis

Decrease neonatal mortality rate

Self-sustaining and cost-efficient

Eco-friendly and safe

It’s mind boggling that something as simple as unsanitary medical tools can end so many babies’ lives

Our intervention will be low cost and sustainable in the long term, and will prevent thousands of neonatal infections over time.

Join us in our efforts to solve the neonatal crisis

Appendix

Presentation Slides

Appendix

Problem Statement

Solution

Logistics and Finance

Risks and Mitigations

Impact

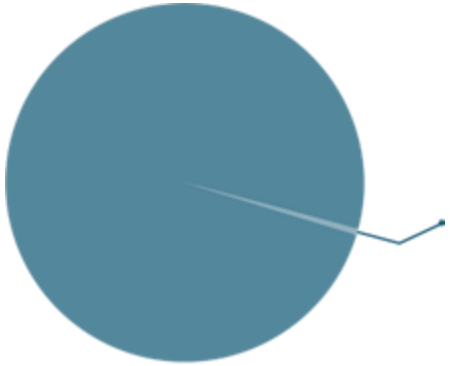
Appendix A1: Official Problem Statement

Appendix A: Problem and Analysis

Pakistan has the second highest neonatal death rate in the world (The World Bank, 2019). The use of unsterilized equipment when cutting the umbilical cord contributes to 1 in 5 Pakistani neonates developing omphalitis, an infection of the umbilical cord that often leads to death.

Appendix A2: Structural Causes of Neonatal Mortality in Pakistan

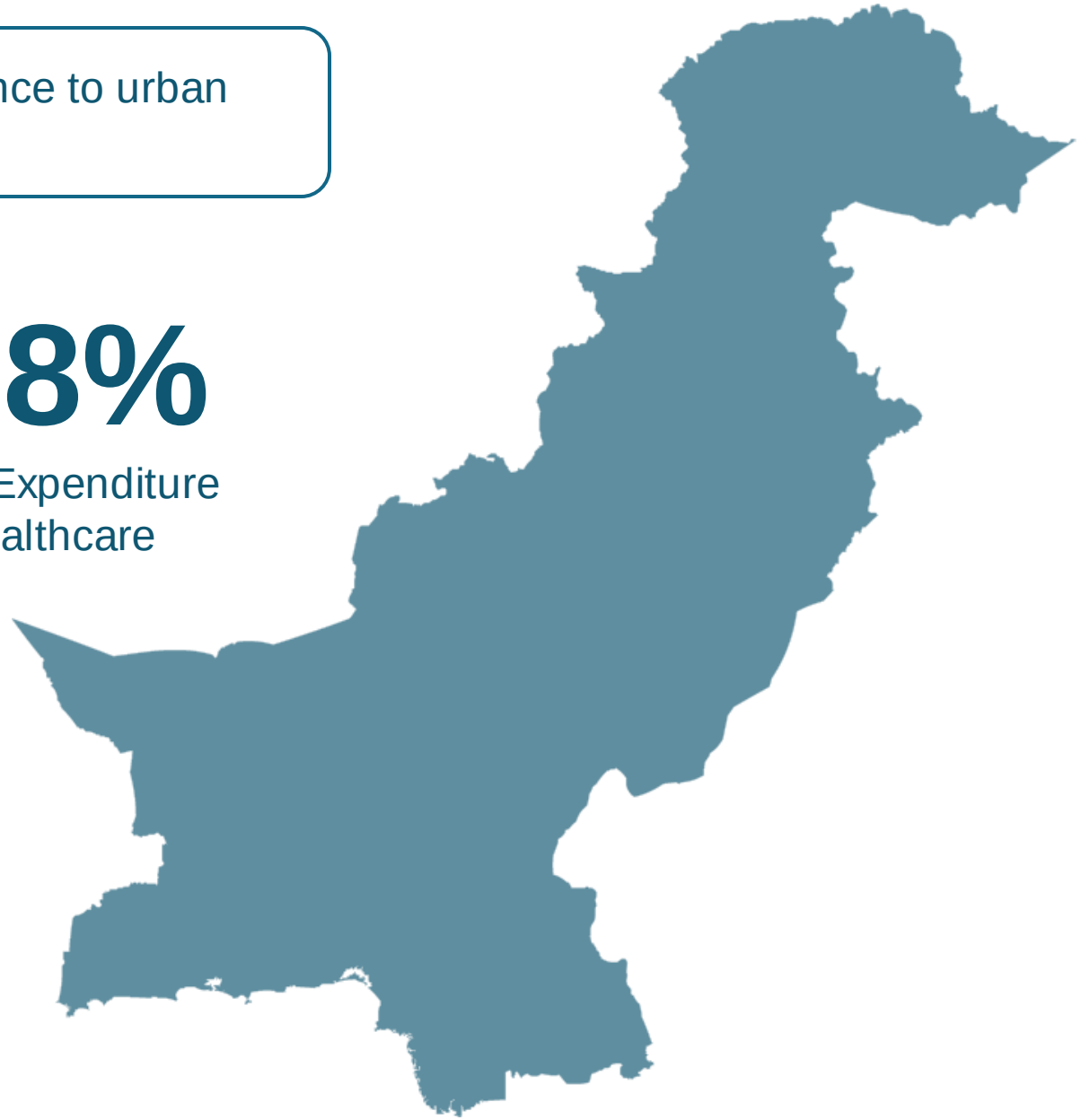
1. Lower socioeconomic status
2. Distance to urban areas



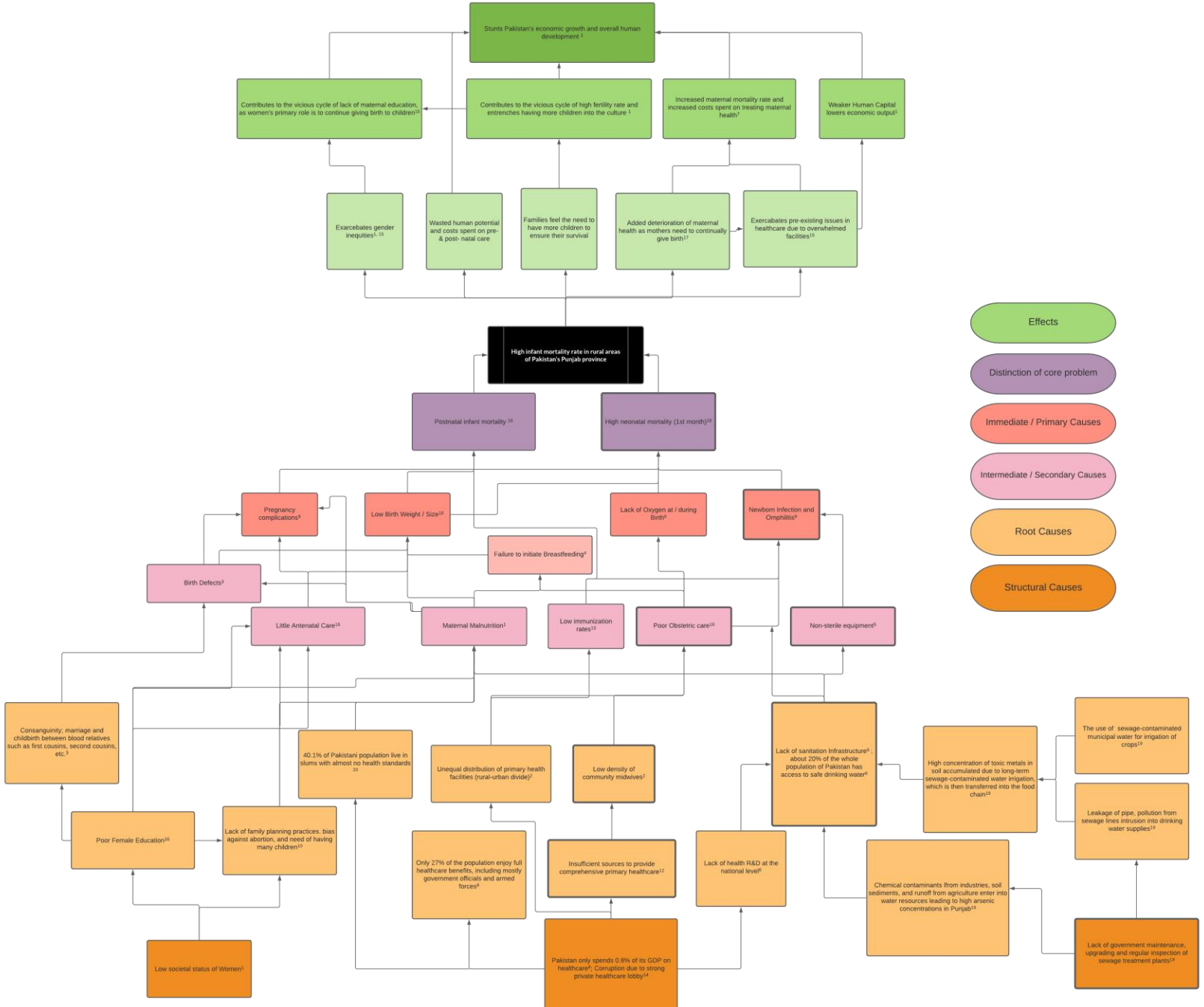
0.8%

GDP Expenditure for Healthcare

3. Unequal distribution of primary healthcare facilities
4. Shortage of health workers
5. Lack of adequate sanitation in rural regions



Appendix A3: Detailed Problem Tree



Appendix B1: Case Study of Solar-Powered Autoclave in Mumbai, India

Appendix B: Solution

- IIT and MIT engineers previously tested a prototype in Mumbai
- In the Mumbai tests, even though the sky was hazy and cloudy, providing only 70 percent insolation compared to a sunny day, the device succeeded in producing the saturated steam needed for sterilization for the required half hour period
- The test was carried out with a small-scale unit, only about a quarter of a square meter, about the size of a hand towel, but it showed that the steam production rate was sufficient that a similar unit of somewhere between 1 and 3 square meters would be sufficient to power a benchtop autoclave of the kind typically used in a doctor's office
- More info can be found on MIT's news site: https://news.mit.edu/2020/autoclave-sterilize-medical-solar-1118

Massachusetts Institute of Technology

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
भारतीय प्रौद्योगिकी संस्थान मुंबई
ज्ञानम् परमम् ध्येयम्

Appendix B2: Autoclave Specifications

Appendix B: Solution

We aim to develop a stationary solar thermal device capable of providing the required saturated steam. Enabled by an optimized transparent aerogel layer, the device can efficiently convert solar energy into heat to drive the steam generation process. Successful sterilization cycles were demonstrated in a field test conducted in Mumbai, India. As a general approach, this work also promises further development of solar thermal technology in energy conversion, storage, and transport applications.

A tube-fin absorber (Thermafin Manufacturing, 127 mm × 965 mm) made of copper with a selective solar absorbing coating was used for its high solar absorptance, low infrared emittance, and high thermal conductivity. The backside of the absorber was insulated by a 50 mm thick fiberglass sheet. The absorber was enclosed in a protective aluminum enclosure and the top aperture was covered by a sheet of borosilicate glass (Swift Glass, 3.3 mm thick). Ten transparent aerogel tiles (150 mm × 100 mm × 7 mm) were placed on top of the absorber surface in place of the air gap in conventional solar collectors. A non-tracking CPC with a geometric concentration ratio of 2.13× (acceptance angle = 25°) was fabricated by bending two pieces of thin aluminum mirrors into a parabolic shape. The CPC provides a simple way to increase the input of solar power without active diurnal tracking. Additionally, because of the low concentration ratio, the CPC is also able to harness a fraction of the diffuse solar radiation, which is beneficial for operation during cloudy and hazy weather conditions.

To fully leverage the benefit of the aerogel, its thickness needs to be carefully chosen to balance the gain in thermal insulation and the loss in optical transmittance. As the aerogel thickness increases, the solar transmittance deteriorates while the thermal insulation improves. The optimal thickness depends on the operating conditions such as absorber temperature and solar radiation flux.

Appendix B3: Alternative Solutions

Appendix B: Solutions

Neonatal Kits: Upon recognizing how multi-faceted the issue of infant mortality in Punjab, Pakistan is and acknowledging its interconnectedness, we initially planned to propose the delivery of holistic neonatal kits in collaboration with the Lady Health Worker Program to provide mothers with resources such as instructional images related to breastfeeding, water purifying packets, and locally sourced nutritious foods. Neonatal tetanus is estimated to account for 40% of all neonatal deaths in developing countries (Fikree, Azam, and Berendes 2002). In Punjab, unhygienic delivery practices such as the application of ghee and cow dung to the umbilical cord serve as significant risk factors for neonatal tetanus (Fikree, Azam, and Berendes 2002). The significance of breastfeeding is also underestimated due to parental lack of education; a study found that the majority of parents in rural Pakistan believed that "the first thing given to an infant after birth should not be breast milk but honey, rose flower, or goat's milk from the hands of an elder in the family or a religious person" (Zakar et al. 2018). Parents are also uninformed on cleanliness measures and hold misconceptions about the benefits of essential sources of nutrition for infants, such as colostrum, often preventing mothers from giving it to their newborns (Zakar et al. 2018). Though neonatal kits would tackle the issue from a variety of angles, we quickly realized that such an intervention would require the involvement of numerous intermediaries and a complex supply chain, and therefore would not be self-sustaining. We acknowledged that we were being excessively optimistic with this solution and decided to tackle one specific issue within the overarching issue of infant mortality: the lack of sanitation.

Kangaroo Mother Care Units: Kangaroo mother care (KMC) is the practice of early and continuous skin-to-skin care between the preterm infant and mother, coupled with exclusive breastfeeding (WHO et al. 2003). KMC has been proven to be a cost-effective alternative to incubators and has reduced neonatal deaths caused by preterm birth (Ruiz-Peláez, Charpak, and Cuervo 2004). However, we recognized that there were numerous barriers associated with this intervention. Healthcare workers such as Lady Health Workers often do not understand the benefits of KMC to mothers, especially since there is a prevalent shame, guilt, and stigma associated with having preterm babies (Seidman et al. 2015). Taking into account the cultural barriers, we realized that many fathers adhere to the belief that childcare should be the role of the mother, and many working fathers were found to disregard KMC (Seidman et al. 2015). Conclusively, we realized that it is a highly behaviour-driven intervention whose success relies on high user engagement and stakeholder involvement—all of which are quite subjective factors that are difficult to control.

Appendix B4: How do we make sure that our solution is sustainable in the long-run?

Appendix B: Solution

1. We need to ensure that we understand the ground situation
    1. Spoke to 5 experts who have worked in rural Pakistan; they spoke about their experiences there and provided recommendations for us to consider
    2. If this project is to be launched, we must travel to the location to get the experience ourselves
    3. Our partners: Medicare Health Foundation and InstaEnergy are familiar with the ground situation and will continue to remain close contact with the intervention location + our team
2. We need to form stronger relationships, and *partnerships within Pakistan*
    1. We spoke to Dr.Shabina and Dr.Sajid from AKU, who have clearly expressed interest in collaborating with us
    2. They have the necessary relationships, and many research teams who are currently tackling infant mortality at AKU

Appendix C1: Major Stakeholders we spoke to

Appendix C: Logistics and Finance

Anam Qadri - Director Resource & Research Medicare Health Foundation

Dr. Anam Qadri is an alumni of the prestigious Lahore School of Management Sciences and has made giving back to society her life goal. She currently serves as the Director of Resource and Research at Medicare Health Foundation. At Medicare, she is in charge of the Mother and Child Health Center which was established in 2015, when the Dutch Embassy in Pakistan provided the funding for it. Dr. Anam plays a key role in the deliverance of our intervention as she has numerous experience with projects of a similar nature. She is also a part of Rotary Pakistan, where she has been leading the efforts to eradicate polio within Pakistan - targeting the most rural of areas. Due to her vast experience in the field, she has amassed great contacts and connections with many other stakeholders which we have shortlisted. Therefore, we felt it right to place Dr. Anam under our high power list, as with her knowledge and experience by our side would be greatly beneficial in implementing our final intervention.

Firstly, she believed that for such a project to have a lasting impression, there needs to be a proper funding schedule that should be approved beforehand as a lot of recent projects within Pakistan have been halted midway due to the lack of funding and at times, discontinued interest of the investor.

Furthermore, she addressed that due to the current COVID-19 pandemic, implementation would not be as easy as it may have been a year ago and as the majority of our group is not situated within the country, it would be hard to manage things from afar.

Ujala Nayyar - World Health Organisation

Dr. Ujala Nayyar is the current Provisional Surveillance Officer of the World Health Organization for Pakistan and has played an instrumental role in the fight against polio within the country. Dr. Nayyar has great connections within the provincial health ministry as well as being an important member of the committee on Partnership for Maternal, Newborn and Child Health. The MNCH Program serves as the government of Pakistan's solution to the problem at hand. Therefore, placing Dr. Ujala under the category of high power due to her experience in the field as well as vast research knowledge on the matter at hand.

She informed us that with projects like these, you need to give them the proper time as you can not get results overnight and that this at times can be a tiresome and grueling process. Similar to Dr. Anam, she also pointed out that implementation of this project would be a great obstacle for our team and that the best way to execute such a project would be to be on the ground as carrying out such a project remotely will have its disadvantages.

Appendix C2: Experts we spoke to

Appendix C: Logistics and Finance

Dr. Shabina Ariff
Aga Khan University Hospital, Karachi | AKUH · Department of Paediatrics and Child Health
FCPS PEADS, FCPS NEONATOLOGY

- Conducted the experiment on neonatal kits
- On-the-ground experience and interactions with LHWs and other members of the primary, secondary and tertiary healthcare departments
- Spoke about the key obstacles to face, especially with Pakistan's healthcare management system
- Received feedback for interventions proposed
- Provided key insights on the reality of community members in rural Punjab Province

Dr. Sajid Soofi
Aga Khan University, Pakistan | AKU · Department of Pediatrics & Child Health
MBBS, FCPS (pediatrics)

Dr. Anushka Ataullahjan
Research Associate at The Hospital for Sick Children
Ph.D., Public Health
Expert in maternal health and neonatal mortality

- Worked actively in rural Pakistan to interact with the community
- Involved in a variety of projects investigating maternal health, infertility, and access to health care in women in Pakistan
- Primary statistical analyst on a research project investigating the relationship between low birth weight and depression in adolescence
- Spoke about potential obstacles (namely cultural barriers) with proposed intervention

Appendix C3: Full Planning of Future Directions

Appendix C: Logistics and Finance

Step 1 - Get our hands on an autoclave and set it up at a hospital

- Use initial funding to fund building the autoclave in the first year
- Follow through with implementation timeline for first year

Step 2 - Create an international university design competition

- Once we have experience with how to actually build an autoclave and get it set up in Pakistan, we will pretty much have the basic logistics down and we will have a proven track record we can use to negotiate with government officials and other potential partners; at this point, we're ready to set up an international university competition for building solar-powered autoclaves
- We will need to create a non-profit competition design committee with students who make up the following departments:
    - Marketing, Web development, Government partnerships, Partnerships/sponsorships, Logistics, Official judges
- Schematics and instructions on how to build the autoclave + information about competition logistics will be put up on a website so any university can access it and take advantage of the autoclave schematics + instructions built in the first year
    - Make sure we have engineering firm's consent to distribute their designs
    - Schools can register for the competition through the website
- The goal of the competition is to build solar-powered autoclaves that are as high efficiency and as low cost as possible
- Any university across the world can participate
- Each university organization is responsible for finding their own sponsors on top of typical club funding to make sure they can pay for designing and building an autoclave
    - Definitely possible since Blue Sky Solar and other existing design teams already do this
    - Engineering companies that produce parts can give discounts, free subscriptions, free products, etc.
    - Banks and other large corporations can provide monetary sponsorships, etc. to cover costs of designing, building, transporting and setting up the autoclave
- Get backers in the form of UN or local governments or corporations; they will contribute to a prize pool
    - Prize pool should be $10,000 - $100,000 for the top team and/or funding towards their school (this incentivizes the school to encourage their students to participate in the competition)
    - Prizes like Nintendo Switches, Surface tablets, and other typical hackathon prizes should be provided too (one for every single design team member)
        - These will be acquired through sponsorships/partnerships
    - Prize pool money could also come directly from the hospitals/governments to benefit from the autoclaves
        - Calculate how much money these governments will save in the long run if they treat these autoclaves as an investment
        - This will get them on board with investing money in prize pool; relatively small amount to invest for essentially free autoclaves being installed in their hospitals
- Every year each team will design and build their own version; and they will submit their designs to be evaluated by a team of expert engineers/scientists
- Regardless of whether the design team wins, as long as their design works it will be used and actually installed in a location that needs it
- The top design team wins the prize pool

Step 3 - Get other universities to participate in the competition and grow it every year

- Get universities in Pakistan on board first and foremost, since they are located where the intervention needs to take place

Appendix C4: Financials

Appendix C: Logistics and Finance

Initial Investment	
1 Aerogel (150 mm × 100 mm × 7 mm)	$ 300.00
2 Other Materials required for Autoclave	160.00
3 Container for device	90.00
4 Shipping Costs	20.00
5 Cost of labour implementation	1,200.00
6 Maintenance costs (6 mos)	200.00
7 Other	80.00
	$2,050.00

Future Directions	
1 App development	$ 500.00
2 Education cards	50.00
3 Community development	400.00
	$ 950.00

1 BuyAerogel.com | Classic Silica™ Tile

2 Case Study

3 Power Pressure Container

Appendix C5: Condensed Implementation Timeline

Appendix C: Logistics and FInance

Implementation of Solar Powered Autoclave

May	June	July	August	Onwards
Negotiate with InstaEnergy for Quote and logistics	Transportation and collection of materials required	Work closely with engineers and researchers	Regularly oversee, maintain, and improve the device	
Further research and determine the target location for intervention	Work with experts & mentors	Build and implement autoclave, ensuring well-functioning device	Plan and launch design competition	
	Travel to location and familiarize with community culture	Work with LHWs, Midwives, traditional birth attendants	Evaluate the usage and effectiveness of the device	

Legend Checkpoint | Planned Implementation | Execute pending prior to success

Build-up and logic of financials

Autoclave Device Costs ($350)

Cost of Aerogel + Other materials required + Container for sterilized equipment

Implementation and Maintenance

Shipping Costs + Labor and Maintenance

Total Costs

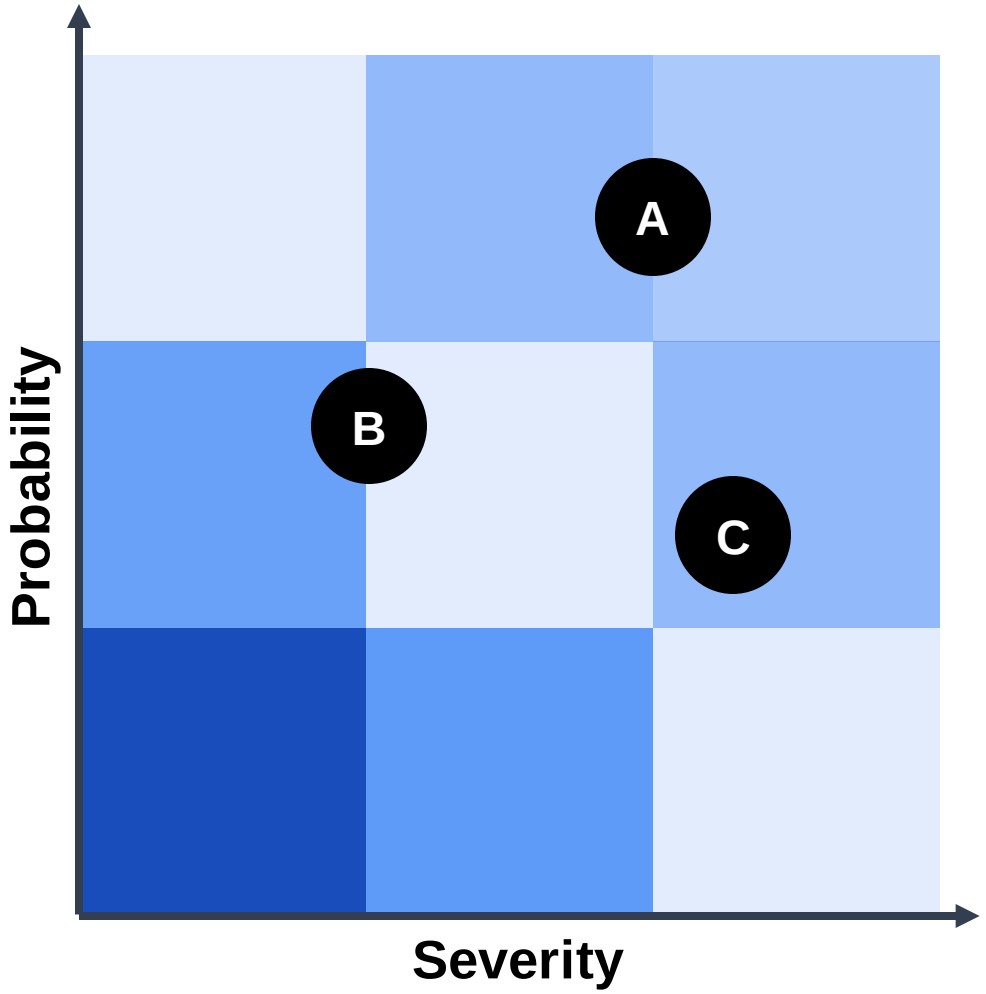
$2,050 initial investment

$950 projections pending

Introduction
Problem Statement
Analysis
Solution
Logistics and Finance
Risks and Mitigations
Impact
Conclusion

Appendix D1: Key Risks and Mitigations

Risks and Mitigations



A

Lack of knowledge regarding the culture of distinct rural communities and religious leaders could make it difficult for community members to accept the autoclave.

Need to interact on the ground-level to familiarize ourselves with the community and communicate with locals. Continue to reference past successful interventions and learn from individuals who have experience with field work in Lahore, Pakistan.

B

The device has the potential to be misused to sterilize other equipment. Furthermore, safeguarding the autoclave would be the biggest threat as crime within the province is high, and parts could be sold in the market.

Install a GPS on the device that can be tracked virtually. Further increase security by adding a proximity sensor and alarm on the device that turns on at night.

C

The intervention would require approvals from a variety of intermediaries. Flaws in the design of the device or other issues may prevent us from receiving such approvals. This is combined with issues related to timing and funding, which may threaten our overall likelihood of success.

Before deployment, refine the logistics of the intervention by seeking expertise and working closely with stakeholders. Account for emergency and mistake costs.

Appendix D2: Secondary Risks and Mitigations

Appendix D: Risks and Mitigations

D

Although the device can be placed in a rural region of Lahore, Pakistan, it is not portable and therefore could still be largely distant (inconvenient) from certain households.

With the implementation of a case design competition, hoping to increase the number of autoclaves that can be implemented near more households. To prevent the distance issue temporarily– work with midwives and traditional birth attendants to accommodate their schedule.

E

The aerogel material is expensive and widely unavailable due to low demand of the material across the globe.

In the long-run the success of the intervention will ideally help commercialize the product. Furthermore, the case design competition may come up with autoclaves that do not require aerogel.

F

The autoclave needs to supply 30 minutes of pressurized steam to properly sterilize equipment. This may be a source of impatience for anyone waiting for the equipment and hinder the schedule for a Lady Health Worker.

Work with LHWs, midwives, and traditional birth attendants in preparing for their birth deliveries. For future directions, could consider hosting short information sessions that are relevant to birth delivery.

G

Weather conditions are to play a vital role, as sunlight required may not be available all the time.

Therefore, adding a battery may be a viable alternative but it comes at a high cost.

H

As this is an engineering solution, the logistics of deploying the solar-powered autoclaves is a key area of focus. We need researchers and engineers involved due to the current team's lack of experience.

Work closely with engineering and research teams when designing and manufacturing the – we will have to outsource the tasks to either solar companies or engineering design teams.

I

Instructions and documentations of technology are in English, creating a language barrier

and would have to be adapted to respective local language to ensure efficient maintenance

J

Various stakeholders such as government health officials or Lady Health Workers could obstruct the intervention

Will need to consider constantly working with management system and maintaining close relationships with the community.

Appendix E1: Full list of benefits of the Intervention

Appendix E: Impact

- The solar-powered autoclave can sterilize medical tools in a self-sustaining fashion. It uses the power of sunlight to generate steam passively.
- The self-sustaining project is cost-efficient. As its source of power is virtually free, the only other costs incurred include an upfront investment cost and low maintenance fees.
- The device does not take up much physical space—can be conveniently placed into an existing communal area in rural Pakistan.
- Lady Health Workers, Midwives, Traditional Birth Attendants and other individuals involved in helping mothers give birth would be able to use sterilized equipment in their deliveries.
- Low maintenance requirements for the device as it can be left on its own to function properly.
- Our solution is also eco-friendly, as it uses solar energy instead of fossil fuels, hence reducing the risk to the environment.
- 1 in 5 kids born in Pakistan succumb to infections caused by unhygienic equipment. This aims to reduce that number by providing clean, sterile equipment.
- The autoclave's previous case study in Mumbai could be used as a standard and inspiration for project implementation in Lahore, Pakistan.
- Tackles the widely spread and high-priority issue of unsterilized equipment in Pakistan through simple means and low costs

Appendix E2: Full list of Opportunities of the Intervention

Appendix E: Impact

- The project is an opportunity to educate mothers, caregivers, traditional birth attendants and midwives on the importance of using sterilized equipment when cutting the umbilical cord of a newborn baby.
- The existing Lady Health Worker Program has successfully carried out many past interventions, and if this device is used successfully then it could be introduced into their program and aid in their work for birth deliveries.
- Can be used as a benchmark for other third world countries to adopt such a phenomenon.
- Will incentivize rural families and bring grassroot level awareness about good hygiene and a sterile environment.
- We can collaborate with manufacturers of the required materials. Corporations often receive incentives for charity work or for collaborating with NGOS, which can help us build relationships with such organizations
- We can collaborate with engineers and researchers from MIT/IIT who originally worked on solar-powered autoclaves and tested them in Mumbai
- We can reach out to nearby hospitals, healthcare institutions, and NGOs working on a similar issue to gain additional funding. Collaborating with such organizations can also help us in the supply chain process
- Production of aerogel within local companies will help boost the solar energy sector of the country.
- Designing more solar-powered autoclaves would improve research in solar energy, Aerogel, autoclaves, and equipment sterilization
- If the solar panels generate excess energy, it can be stored in a battery or fed back to the grid