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Saving lives, by design: Using systems thinking To combat maternal mortality In India

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SAVING LIVES, BY DESIGN
SYSTEMS THINKING TO ADDRESS MATERNAL DEATH IN INDIA

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JHPIEGO & Johns Hopkins University win a significant financial grant on Saving Lives at Birth.
RESEARCH

understanding the context
WHAT IS MATERNAL MORTALITY?

Pregnancy-related death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death.
A burning issue in the developing world
Maternal mortality ratio (per 100,000 live births), 2010

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

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MOTHER’S DEATH - DISINTEGRATION OF THE FAMILY STRUCTURE
CLINICAL IMMERSION
journey into the void
Johnson & Johnson, Mumbai
Lilavati Hospital, Mumbai
All India Institute of Medical Sciences AIIMS, New Delhi
Calcutta Medical College - 200 deaths in a week!
EMERGENCY
DIAL 102

AMBULANCE ACCESS FOR ALL
3 countries
29 days of travel
4000 km covered in India, Kenya, Nepal
7 cities
11 villages
8 months of work

45 midwives
23 doctors
19 doctors in residency
8 medical experts
6 public health experts

300+ pages of data
MAKING SENSE OF THE DATA
mapping systemic relationships
Can the systems model be a visual metaphor of the child in the womb?
External factors that impact maternal mortality
Identification of 3 leverage points in the system

Maternal Anaemia: Before the pregnancy

Pre Eclampsia: During pregnancy

Post Partum Haemorrhage: After birth
IDEA GENERATION > BUCKET LIST
KEY QUESTION - HOW CAN WE PREVENT WOMEN IN DEVELOPING NATIONS FROM BLEEDING TO DEATH?
IDEATION WITH DOCTORS, MIDWIVES, BIOMEDICAL ENGINEERS & DESIGNERS
Doctors like medical solutions
Engineers like technology
Public health experts love policy
&
Designers make emotional decisions!

Can we find a logical way of identifying true inflection points in the system?
We identified over 100 opportunities or issues to be tackled...

But how do we sort the issues according to amount of impact?
Generation of solutions and categorization based on criticality in the system

- Quick availability of transport
  - Ability of accompanying health worker to conduct delivery during transport
  - Create oxytocin that is stable at room temperature
- Ability of health worker to administer uterotonics
  - Oxytocin packaging that is capable of creating cold storage condition and keeping it cold
- Misoprostol distribution to pregnant women
  - Train relatives, friends or close neighbors to perform uterine massage
- Ensuring that every pregnant woman gets her share of Misoprostol through everyday supply chains or easily accessible sources
  - Encourage woman to donate blood for herself before she gets pregnant itself
  - Simple blood donation kit to facilitate autologous blood donation at the village center
  - Simple ways to stop or slow down bleeding
- Identify matching blood donor in the family or friends circle who is ready to donate blood in the early stage of pregnancy
  - Availability of sterile uterine packing material
- Delay onset of shock
  - Low cost anti-shock garment
- Educate woman about the importance of keeping the bladder empty during labor and the immediate postpartum period
- Uterus monitoring device
  - Misoprostol packaging that would refuse to open unless it is sure that the time is right for its usage
  - Reminders to empty bladder regularly
- Blood loss measuring device that starts transfusing blood when the amount of blood lost crosses the normal amount based on its knowledge of the woman’s Hb level
- Quick and easy way to sterilize available material for uterine packing before putting it into the uterus
- Replace clotting factors
- Training days
  - Instill trust in the pregnant woman towards her local health worker’s advice
  - Strengthen incentive structure for ASHA’s and pregnant women going for institutional deliveries
- Availability of trained health personnel to accompany woman during transport
  - A device that can assist during AMTSL. Capable of delivering uterotonic dosage based on the level of tonicity of the uterus. Capable of performing/assisting/giving instructions about uterine massage
  - A way to ensure that the woman does not consume Misoprostol before the prescribed time
  - A way to store the autologous blood donated at home for easy access in case of need
- Simple and cheap cold storage for oxytocin
  - Inhalable oxytocin dry powder that does not require cold storage
  - Train the woman to massage her own uterus
- Means other than cold storage to prevent oxytocin from degrading
- Uterine massage aid
- Misoprostol packaging that does not require cold storage
  - A product that can do both qualitative indication of uterine tone and restore contractions by simple massage simulations
  - Simple self Hb level checking device
  - Replace clotting factors
Generation of solutions and categorization based on criticality in the system

PRODUCT BASED INTERVENTIONS

- Efficient cold storage facility for oxytocin
- Home-made PPH readiness kit
- Inhalable dry powder oxytocin that does not require cold storage
- Easy to use oxytocin dry powder inhaler
- Misoprostol packaging that would refuse to open unless it is sure that the time is right for its usage
- Uterine massage aid
- A device that gives feedback about uterine tone and stimulates contractions
- Ways to slow down/stop bleeding
- Quick and easy way to sterilize available material before using it for uterine packing
- Simple haemoglobin measuring device
- Simple kit for autologous blood donation
- Simple means of identifying clotting disorder
- Reminder to empty bladder regularly

POLICY BASED INTERVENTIONS

- Facilitate institutional delivery for all women
- Availability of trained health personnel to accompany woman during transport
- Ability of accompanying health worker to conduct delivery during transport
- Ability of health worker to administer uteritones
- Spread awareness about dangers of home deliveries
- Promote institutional deliveries and its benefits
- Quick availability of transport
- Bring down cost of transport for pregnant women
- Proper training for dais
- Regular inspection and updating of equipment and infrastructure
- Strengthen incentive structure for ASHA’s and pregnant women going for institutional deliveries
- A way to ensure that the woman does not consume Misoprostol before the prescribed time
- Insist trust in the pregnant woman towards her local health worker’s advice
- Self-cooling oxytocin packaging
- Availability of oxytocin and appropriate cold storage
- Quick replenishment of uteritones and delivery kits
- Train the woman to massage her own uterus
- Encourage woman to donate blood for herself before she gets pregnant itself
- Identify matching blood donor in the family or friends circle who is ready to donate blood in the early stage of pregnancy
- Availability of blood and blood storage facility
- Distribute misoprostol to all pregnant women
- Educate woman about the importance of keeping the bladder empty during labor and the immediate post partum period
- Make blood donation exciting. A woman who does autologous donation could be given incentives such as free ration, a gold coin, congratulatory framed certificate with her picture on it etc.
DESIGNING SOLUTIONS
POST PARTUM HAEMORRHAGE

After giving birth in a government clinic near her village, Zeinab experienced postpartum hemorrhaging.

By the time she reached the MSF hospital, she had gone into hemorrhagic shock.

KEY QUESTION - HOW CAN WE PREVENT WOMEN FROM BLEEDING TO DEATH?
Generation of solutions and categorization based on criticality in the system.
Three facets of the solution matrix

Technology based interventions
Design based interventions
Policy based interventions
<table>
<thead>
<tr>
<th>ISSUES FACED</th>
<th>Prevailing statistic of 59% home deliveries happening in India</th>
<th>Improper usage and non-availability of effective uterotonics</th>
<th>Uterine massage not performed since it is time consuming and tiring</th>
<th>Late procurement or inability to procure matching blood for transfusion</th>
<th>Lack of effective management of haemorrhage during transport</th>
<th>Difficult to ensure that the bladder is kept empty during home deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design intervention</td>
<td>Home-made PPH readiness kit which could include:  - Sterilized cloth pieces to be used for uterine packing  - Simple battery operated sterilizer for available materials such as old cloth etc. that could be used for uterine packing  - Simple substitute for the NASG (Non-pneumatic anti shock garment)  - Misoprostol tablets  - Commonly available household product which could be used as a uterine massage aid</td>
<td>Low cost, easy to use inhaler to administer inhalable oxytocin developed by researchers in Australia</td>
<td>Uterine massage aid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering intervention</td>
<td>Development of inhalable oxytocin dry powder which does not require cold storage by researchers in Australia  - Self-cooling oxytocin packaging  - Efficient cold storage facility for oxytocin</td>
<td>A device that gives feedback about uterine tone and stimulates contractions</td>
<td></td>
<td></td>
<td>Simple kit for autologous blood donation and storage at home itself</td>
<td>Simple means of identifying clotting disorder</td>
</tr>
<tr>
<td>Intervention through Government policies for human resource development</td>
<td>Strengthen incentive structure for ASHA’s and pregnant women going for institutional deliveries  - Instill trust in the pregnant woman towards her local health worker’s advice  - Proper training for Dais</td>
<td>Train health workers on how to administer uterotonics</td>
<td>Teach the woman to massage and monitor her own uterus  - Train close relatives, friends or neighbors to perform uterine massage</td>
<td></td>
<td>Identify a willing blood donor among family or friends in the early stage of pregnancy itself  - Encourage woman to do autologous blood donation before she gets pregnant or even before she gets married  - A woman who does autologous donation could be given incentives such as free ration, a gold coin, congratulatory framed certificate with her photo on it etc.</td>
<td></td>
</tr>
<tr>
<td>Intervention through Government policies concerning other resources</td>
<td>Regular inspection and updating of equipment and infrastructure  - Provide dais with delivery kits and ensure timely replacement before stocks run out  - Provide quick access to transport and reduce the cost of the same for pregnant women  - Promote institutional deliveries and their benefits  - Spread awareness about the dangers of home deliveries and promote institutional deliveries and their benefits</td>
<td>Quick replenishment of uterotonics  - Availability of low cost &amp; low maintenance cold storage  - Distribute misoprostol to all pregnant women</td>
<td></td>
<td></td>
<td>Availability of blood storage facility</td>
<td></td>
</tr>
</tbody>
</table>
Post Partum Haemorrhage (PPH)

What makes this fatal

Oxytocin when exposed to high temperatures loses its potency and becomes useless to treat or prevent PPH while giving a false sense of security.

A nurse in Jaley Referral Hospital, showing us the drug storage cabinet.

Each ampoule contains:
- Oxytocin IP (Synthetic) eq. to 5 unit of Oxytocin activity per ml.
- Store between 8° to 25°C, DO NOT FREEZE.

'SCHEDULE H DRUG. Warning: To be sold by retail on the prescription of a Registered Medical Practitioner only.'
Detailed Design Brief

Functional aspects

- Ensure that oxytocin is always available only contained within the cooling unit to ensure temperature regulated storage.
- Store 100 ampoules of oxytocin.
- Self-sustaining.
- Does not require electricity.
- Low maintenance.
- Eliminate the need to open the container too often.

Technical aspects

- Super insulation technique employed for cooling.
- Good cold retention or heat repelling properties.
- Dispensing mechanism to dispense one ampoule at a time.
- A cold life of at least 2 months.
- Display screen on the container.
- Display the internal and external temperature.
- Display number of ampoules remaining on the same screen. Or provide a printed roll of numbers like in an analog camera. With each push of the dispensing button, the number visible on the roll would decrease by one.
- Batteries would be required to power the display screen.
- The screen can be eliminated by using an external thermometer to test performance.
- Visual reminders to order for a refilled container when the number of ampoules reduces to a minimum number.
- Visual prompt to take necessary action in case the internal temperature rises above acceptable levels.

Usability

- The dispenser should dispense one ampoule with the user having to exert just a minimum amount of pressure on the dispensing button.
- The ampoule must be dispensed as soon as the button is pushed. There must be no delay or waiting period.
- The dispensing button must be fail-proof.
- The form and positioning of the dispensing button must be such that the user intuitively understands its purpose and usage.
- The display screen should be easy to read and understand.

Ergonomics and Aesthetics

- The opening from which the dispensed ampoule is retrieved should be big enough to allow 95th percentile fingers of the combined male-female user group to comfortably remove the ampoule.
- Project effectiveness and reliability.
- Reflect the serious nature of its purpose and place of usage.

Supply

- Oxytocin ampoules must be supplied only as contained within the storage unit and not lose.
- When one storage unit runs out of ampoules, a backup unit is used while waiting for a replacement unit.
- The empty unit would be replaced with a refilled one.
LOW COST BATTERY POWERED OXYTOCIN COOLER FOR DEEP RURAL LAST MILE CONNECTIVITY
PRE ECLAMPSIA

KEY QUESTION - HOW CAN WE DETECT RISING BLOOD PRESSURE BEFORE IT GETS CRITICAL?
Protein urea detected by dipsticks

Dipsticks are not available!
LOW COST DEVICE TO DETECT PROTEIN UREA IN URINE, CARRIED BY RURAL HEALTH WORKERS, DETECTS UREA WITHIN 60 SECONDS
KEY QUESTION - HOW CAN WE DETECT ANAEMIA BEFORE IT IS TOO LATE?

MATERNAL ANAEMIA
LOW COST ANAEMIA DETECTOR, POWERED BY A SIMPLE PHONE, OPERABLE WITH NO CLINICAL TRAINING
Using the systems model, we were able to generate over 100 opportunities for intervention for addressing mortality spread over design, technology, services, policy & human resources domains.
EVERY 90 SECONDS
A WOMAN DIES FROM
COMPLICATIONS OF
CHILDBIRTH.

WE CAN CHANGE THAT.
Thanks for your patience!

SAVING LIVES, BY DESIGN
RSD3 Systemic Design Symposium, Oslo, Norway