

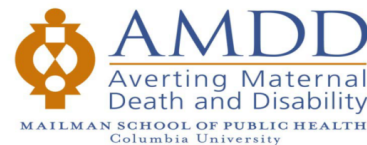
# Measuring the population's access to emergency delivery services, from home to highest referral facility: Mozambique 2012

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# Presentation outline

Background: limits of current measures of access

Using geographic information systems (GIS) to target investments to improve access

- Exercise in Mozambique to inform health planners
- Review two GIS models of access: status quo and improvement scenario

Next steps

- In Mozambique
- Implications/application

# Background: Geographic access

Reducing barriers to access is key to increased use of services and further reduction of maternal and newborn mortality

Traditional measures are crude proxies, can mask areas of poor access and inequities, do not include the dimension of time

Time to reach services should be central to health system assessment and planning.

National assessments of access rarely go beyond the crude traditional measures. Geographic information system (GIS) modeling can fill that gap.

# Using GIS to target improvements in access

**Objective: Provide planners in Mozambique with assessment of geographic access to emergency maternity services that uses time to services**

- Improve the modeling methodology to account for complex trade-offs women make when deciding where to seek services, i.e. bypassing
- Context: woman experiencing a severe obstetric complication, time is of the essence

# Methodology

- Facility data: Mozambique National Assessment of Emergency Obstetric and Newborn Care (EmONC) Services, 2012. Used with permission from the Mozambique Ministry of Health.
- Facility-level quality scores
- Time-bound catchment areas relative to quality level
- GIS modeling

Model 0: Status Quo

Model 1: Improvement - Upgrade strategic facilities

# Quality score – 14 point maximum

## Dimension 1: General facility readiness

1. Open 24/7
2. Electricity
3. Reliable water
4. Motorized transport – any mode (4-wheeled)
5. Communication (landline in facility, two-way radio or cell phone and cell signal)

## Dimension 2: Readiness to provide EmOC signal functions

6. parenteral antibiotics
7. parenteral anticonvulsants
8. parenteral oxytocics
9. manual removal of placenta
10. removal of retained products of conception
11. assisted vaginal delivery with vacuum or forceps
12. neonatal resuscitation
13. blood transfusion
14. cesarean delivery

# Quality levels

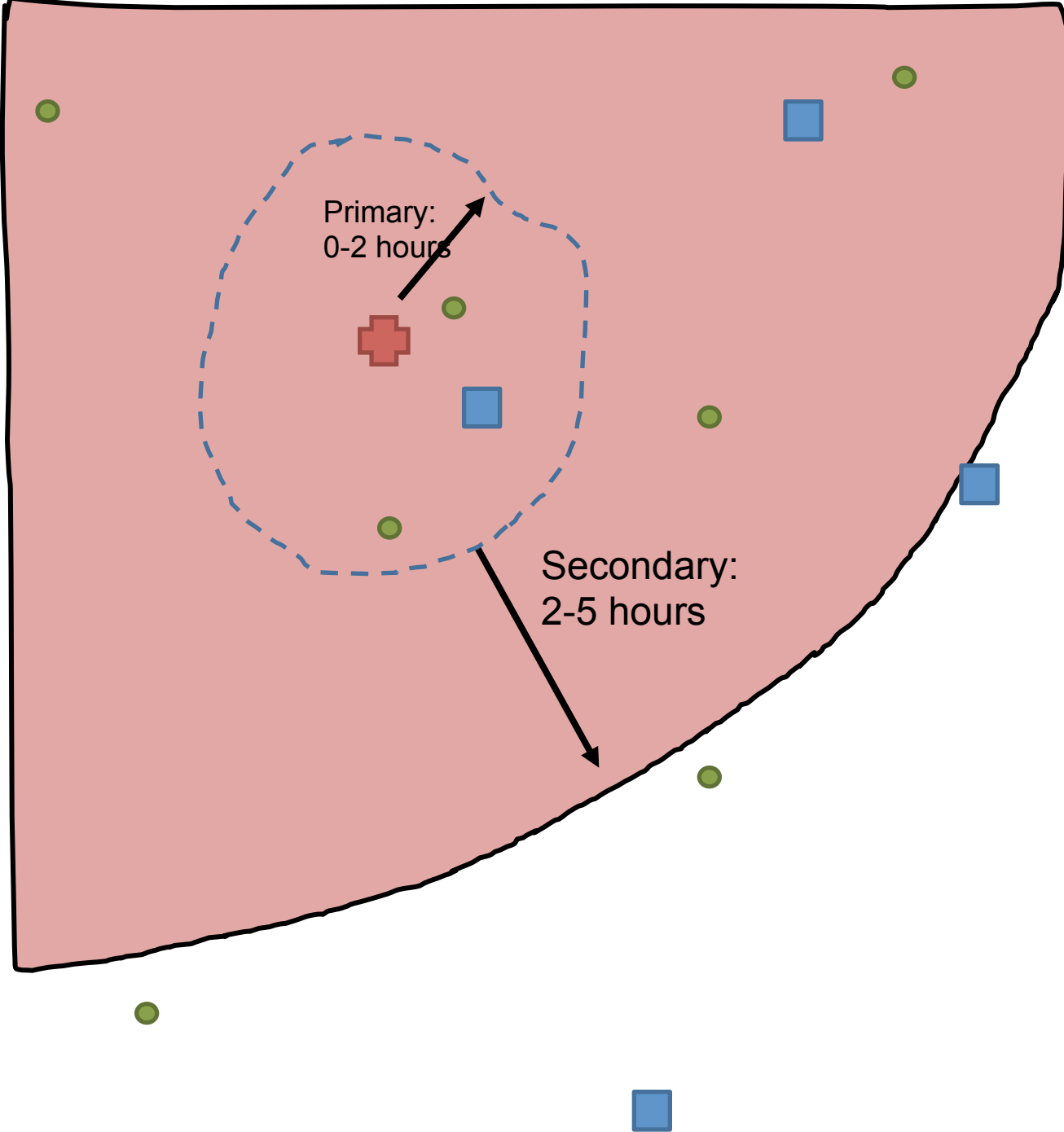
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Quality Score	Other criteria	Quality Level
10 to 14	performed cesarean delivery in last 3 months	Level 5
		Level 4
0 to 9	Has motorized transport	Level 3
6 to 9		Level 2
0 to 5		Level 1

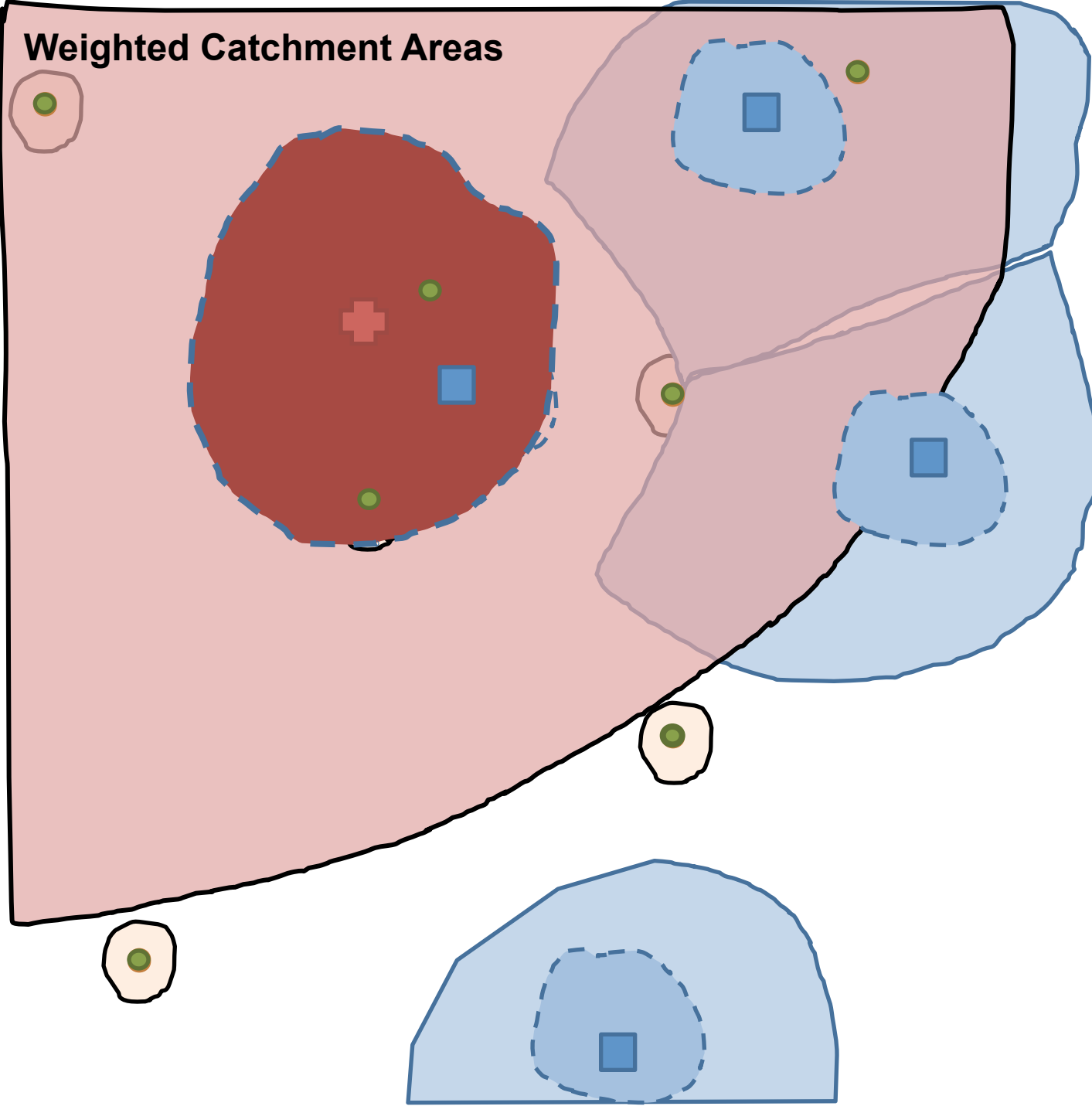
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# Time-bound catchment areas

High quality facilities draw population from further away.







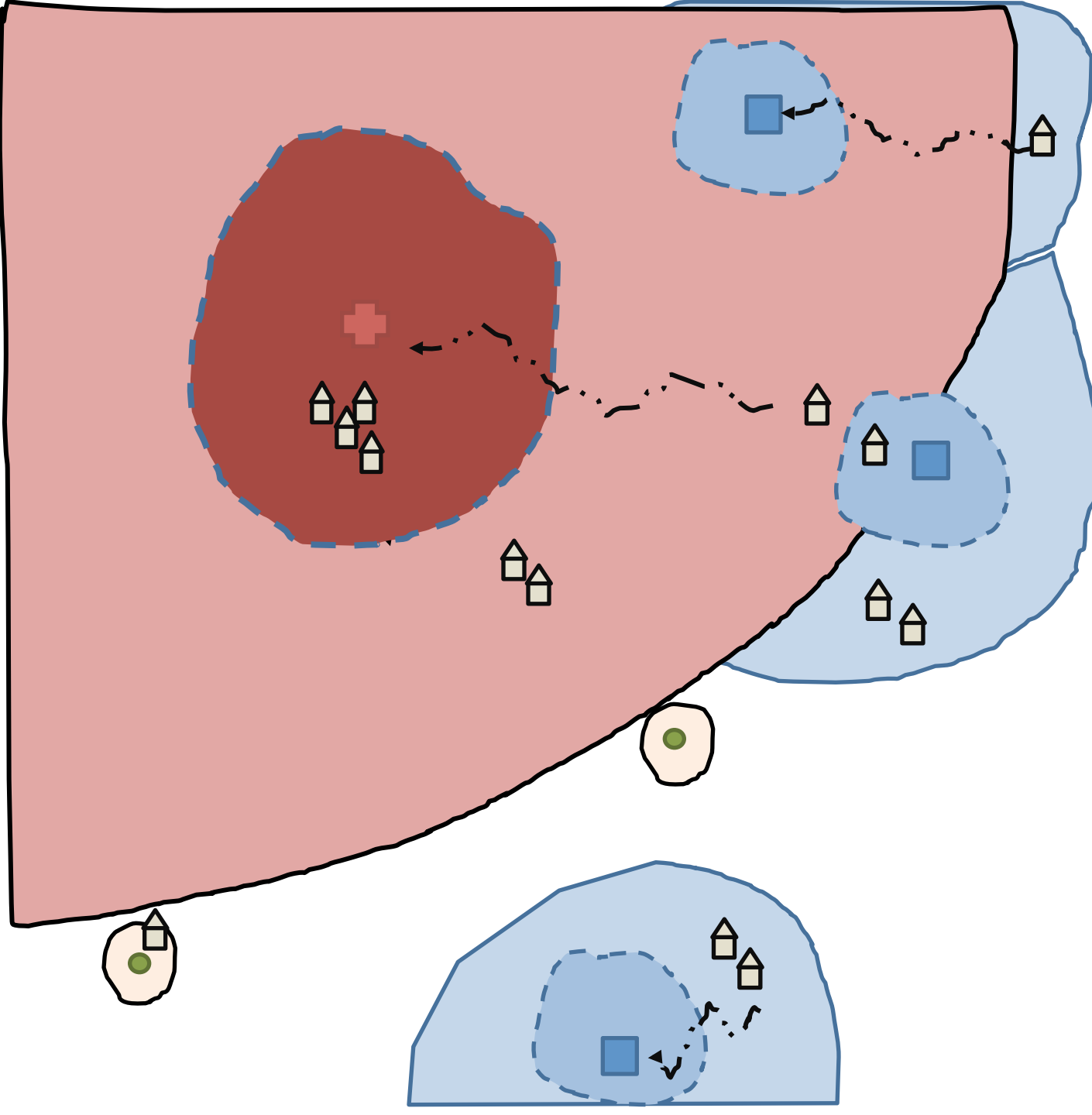
# Time-bound catchment areas

**Medium and Low quality facilities have smaller catchment areas.**

**Overlapping catchment areas are prioritized first by quality level.**

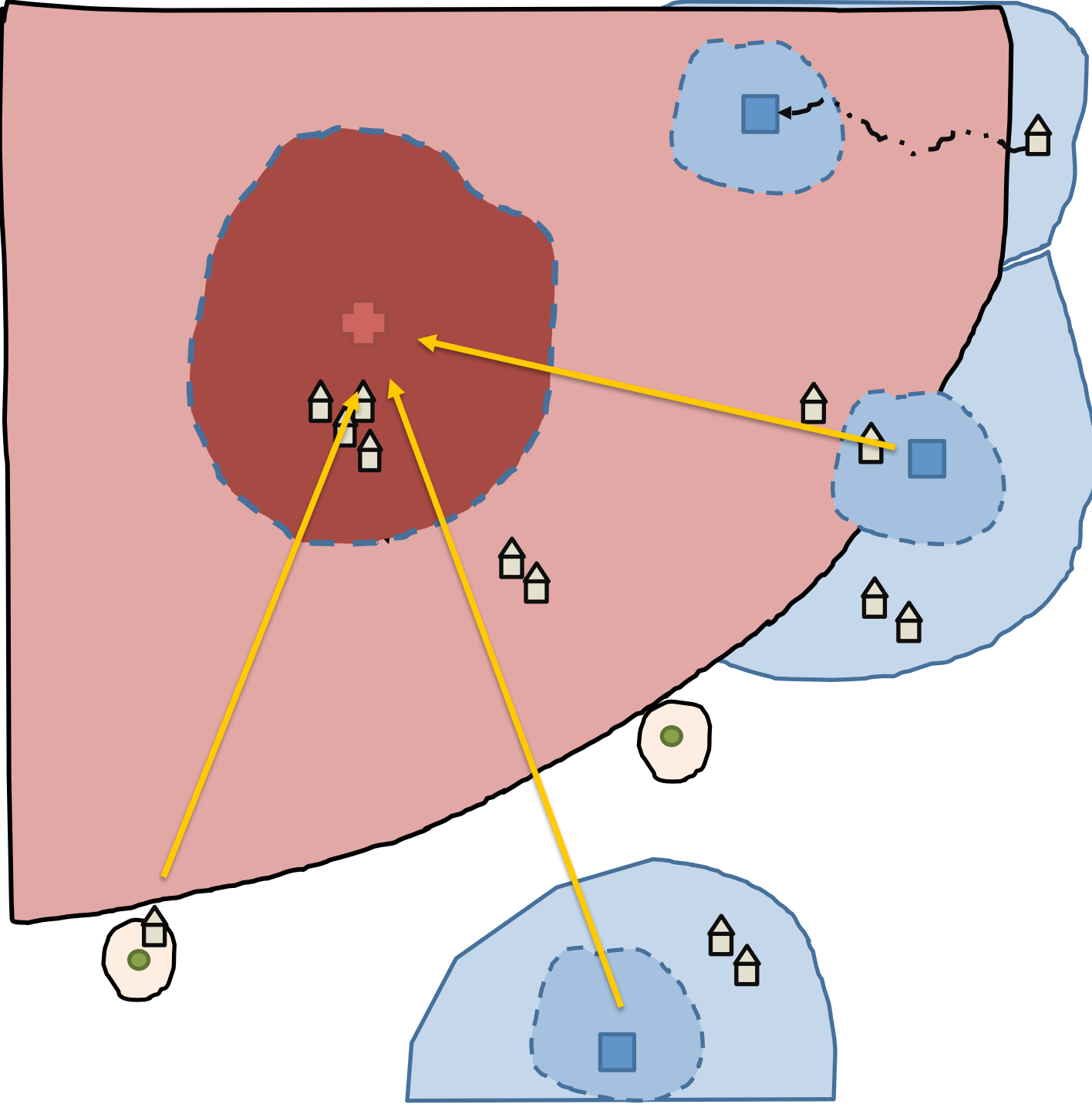
# Time-bound catchment areas

Home to first quality-weighted facility.

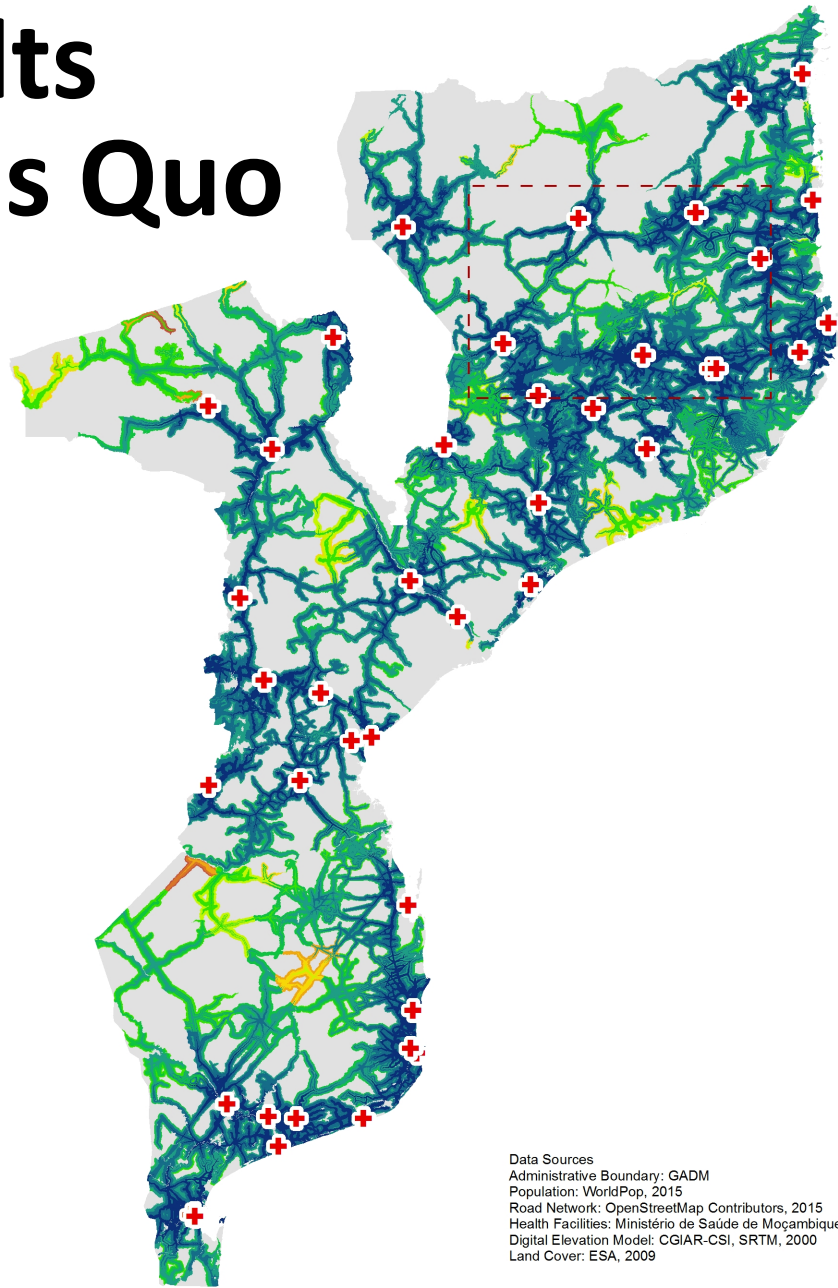


# Intra-facility referral

**Women at lower level facilities may need to be transferred upward to the highest level.**



# Results Status Quo



## Model 0: Catchment Areas of "Highest Quality" Health Facilities by Adjusted Travel Time

Mozambique 2012 Assessment of Emergency Obstetric and Newborn Care\*

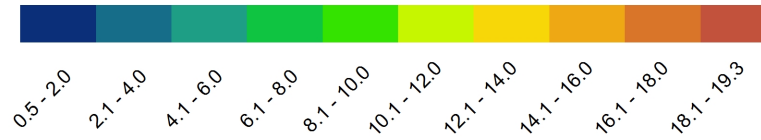
\*Used with permission from Ministério de Saúde de Moçambique (MISAU)

### Health Facility

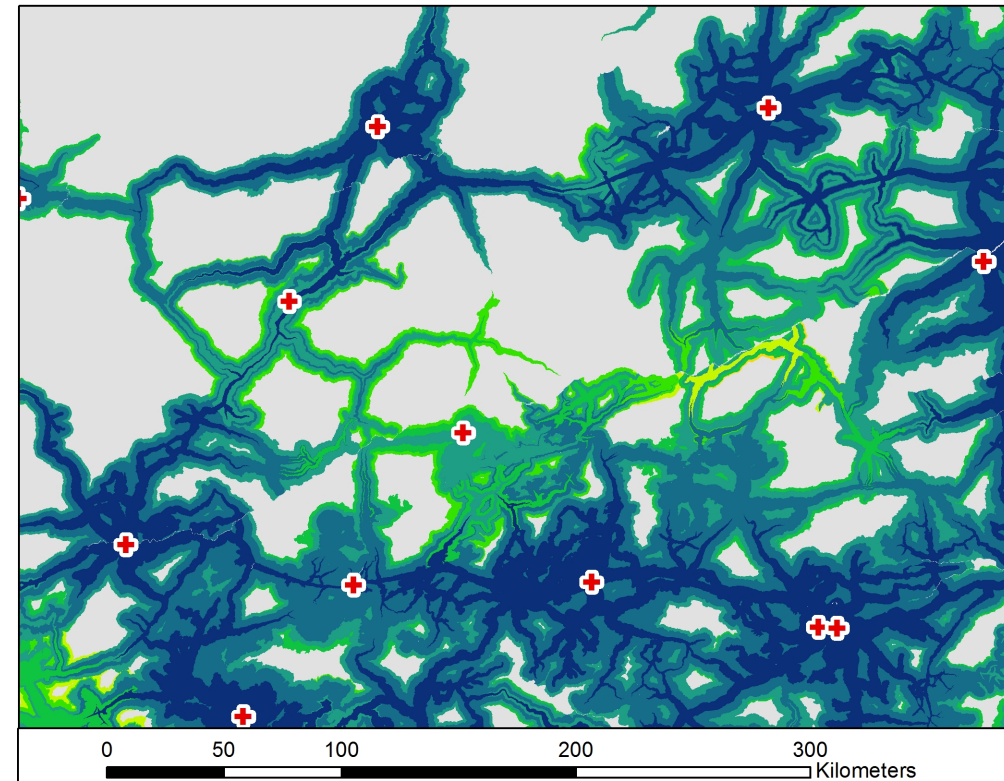
+ Highest Quality (5)

### Adjusted Travel time

#### Hours



Area Enlarged



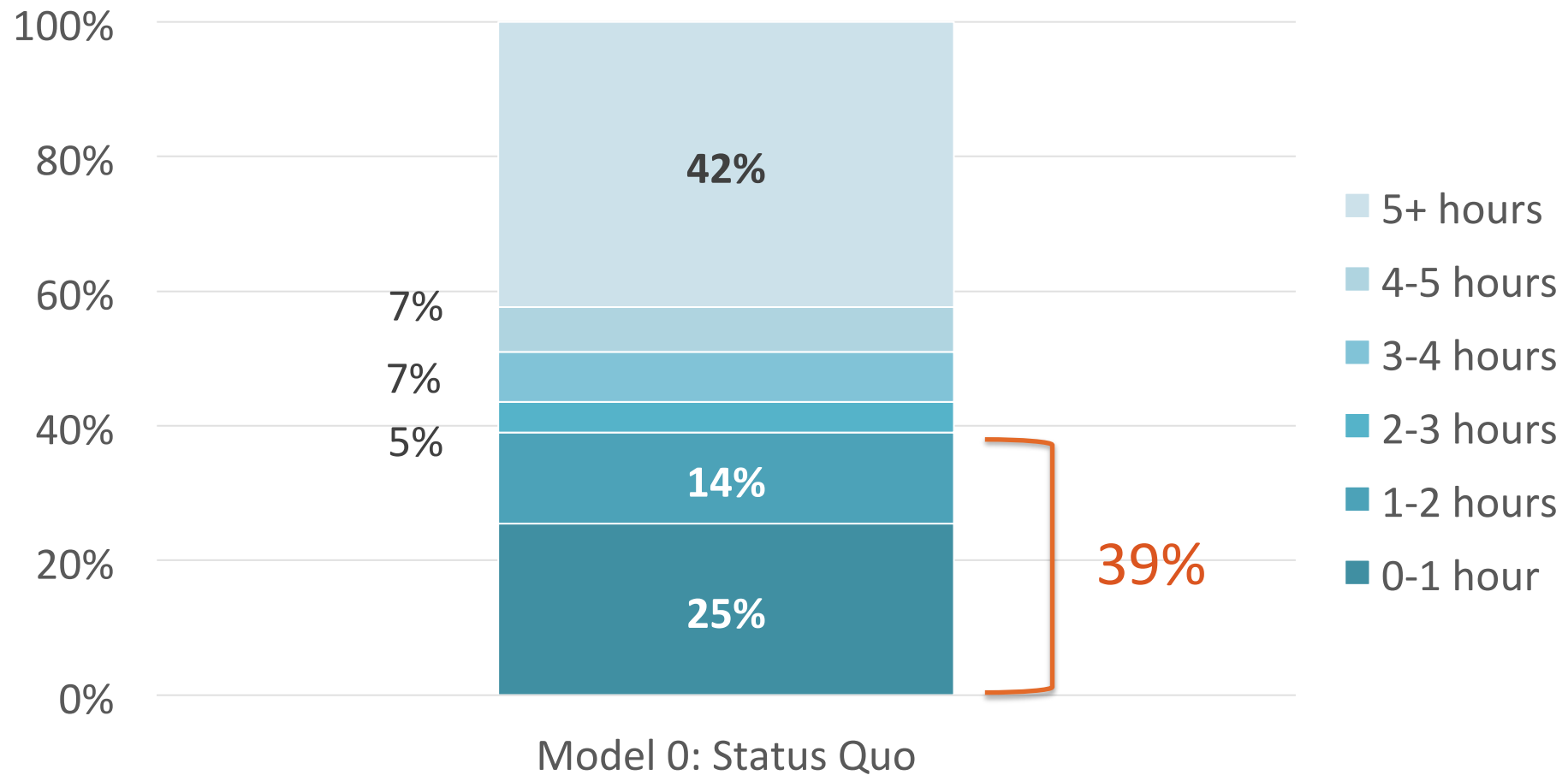
Data Sources  
Administrative Boundary: GADM  
Population: WorldPop, 2015  
Road Network: OpenStreetMap Contributors, 2015  
Health Facilities: Ministério de Saúde de Moçambique, 2012  
Digital Elevation Model: CGIAR-CSI, SRTM, 2000  
Land Cover: ESA, 2009

0 250 500 1,000 Kilometers

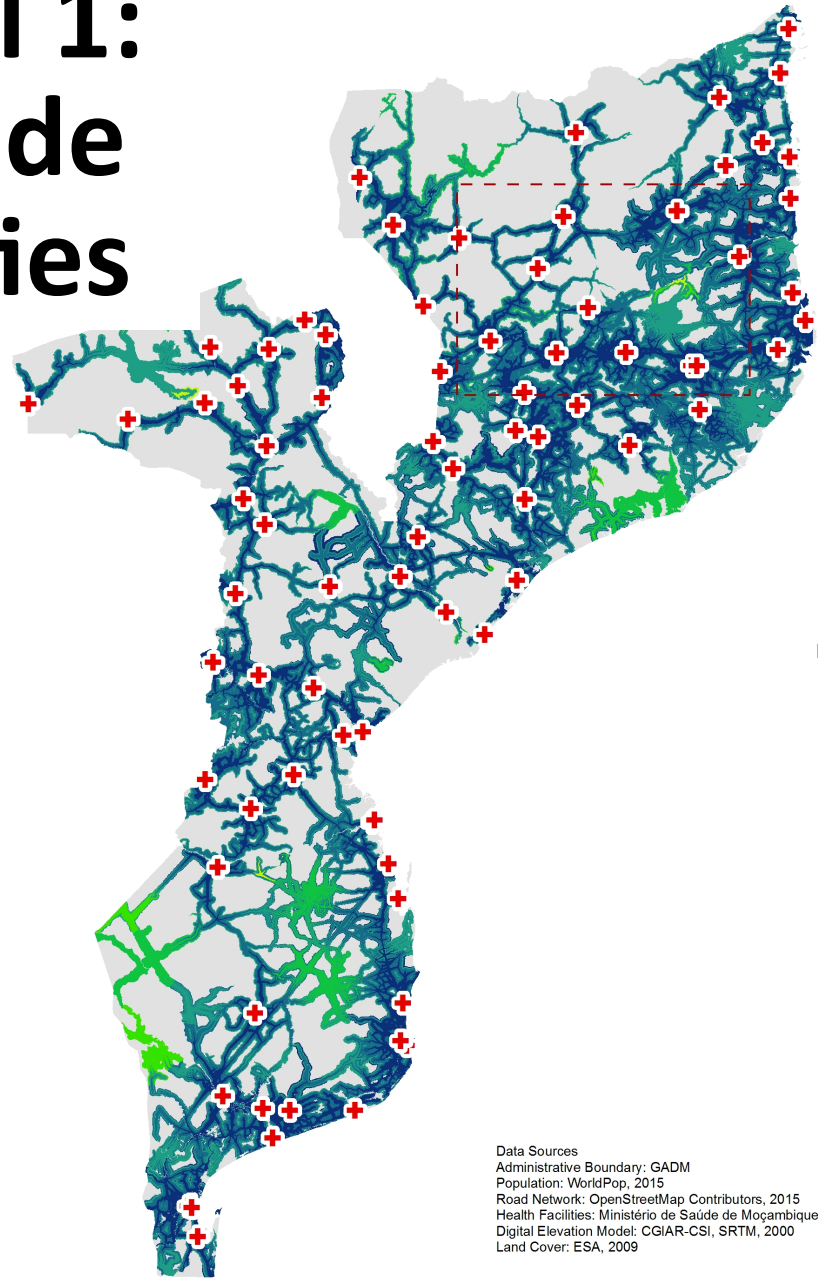
0 50 100 200 300 Kilometers

# Results Status Quo: Home to Level 5 (direct or transferred)

Population with access to Level 5 facility within indicated time interval



# Model 1: Upgrade Facilities



Data Sources  
Administrative Boundary: GADM  
Population: WorldPop, 2015  
Road Network: OpenStreetMap Contributors, 2015  
Health Facilities: Ministério de Saúde de Moçambique, 2012  
Digital Elevation Model: CGIAR-CSI, SRTM, 2000  
Land Cover: ESA, 2009

0 250 500 1,000  
Kilometers

## Model 1: Catchment Areas of "Highest Quality" Health Facilities by Adjusted Travel Time

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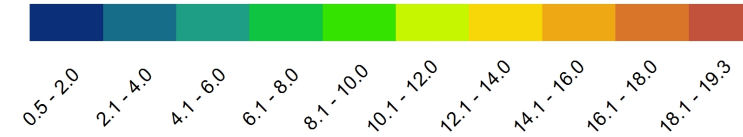
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### Health Facility

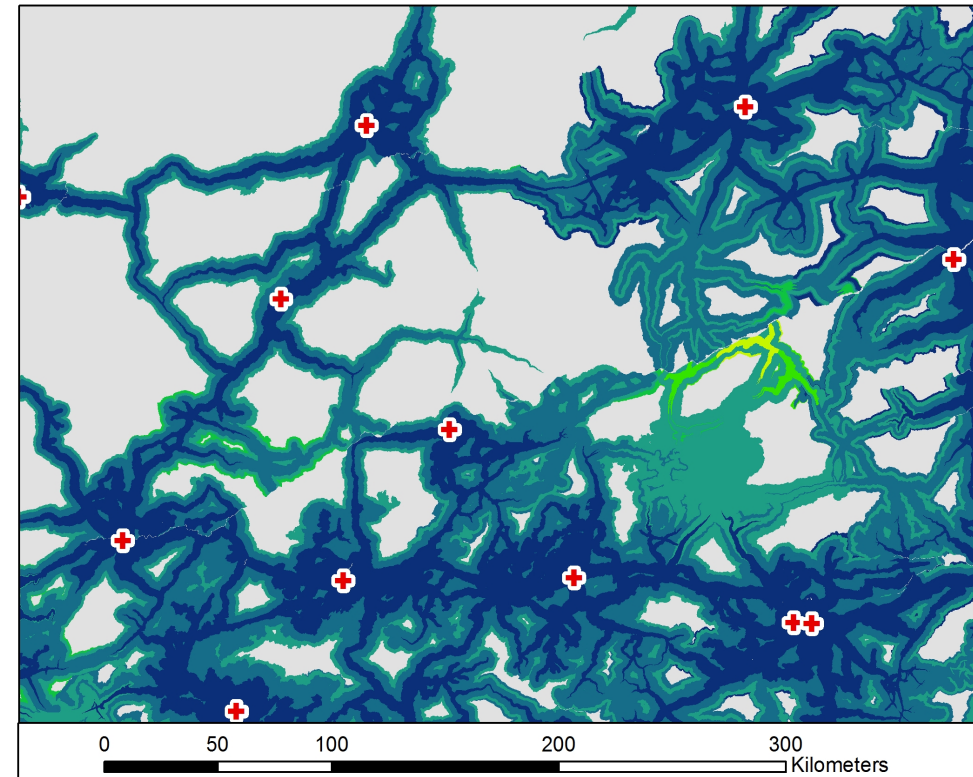
+ Highest Quality (5)

### Adjusted Travel time

#### Hours

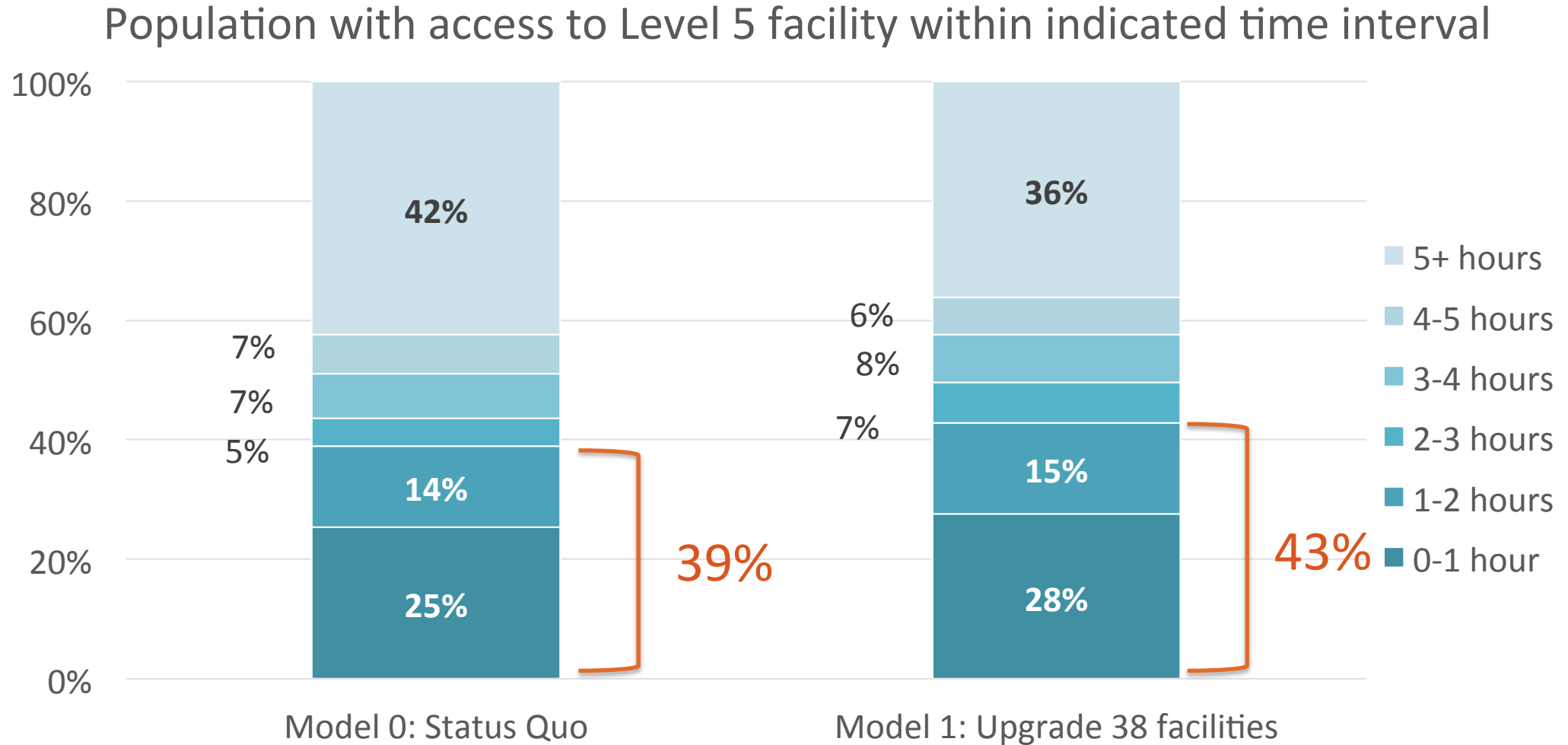


Area Enlarged



0 50 100 200 300  
Kilometers

# Results – Status Quo vs. Model 1



# Immediate next steps and implications

## Mozambique models

- Model Improvement 2: reallocation of referral infrastructure
- Ground truth models in Mozambique (early 2016)
- Cost analysis of each improvement scenario (2016)

## Broader applications

- Apply this approach to other contexts – routine delivery, newborn complications, other countries

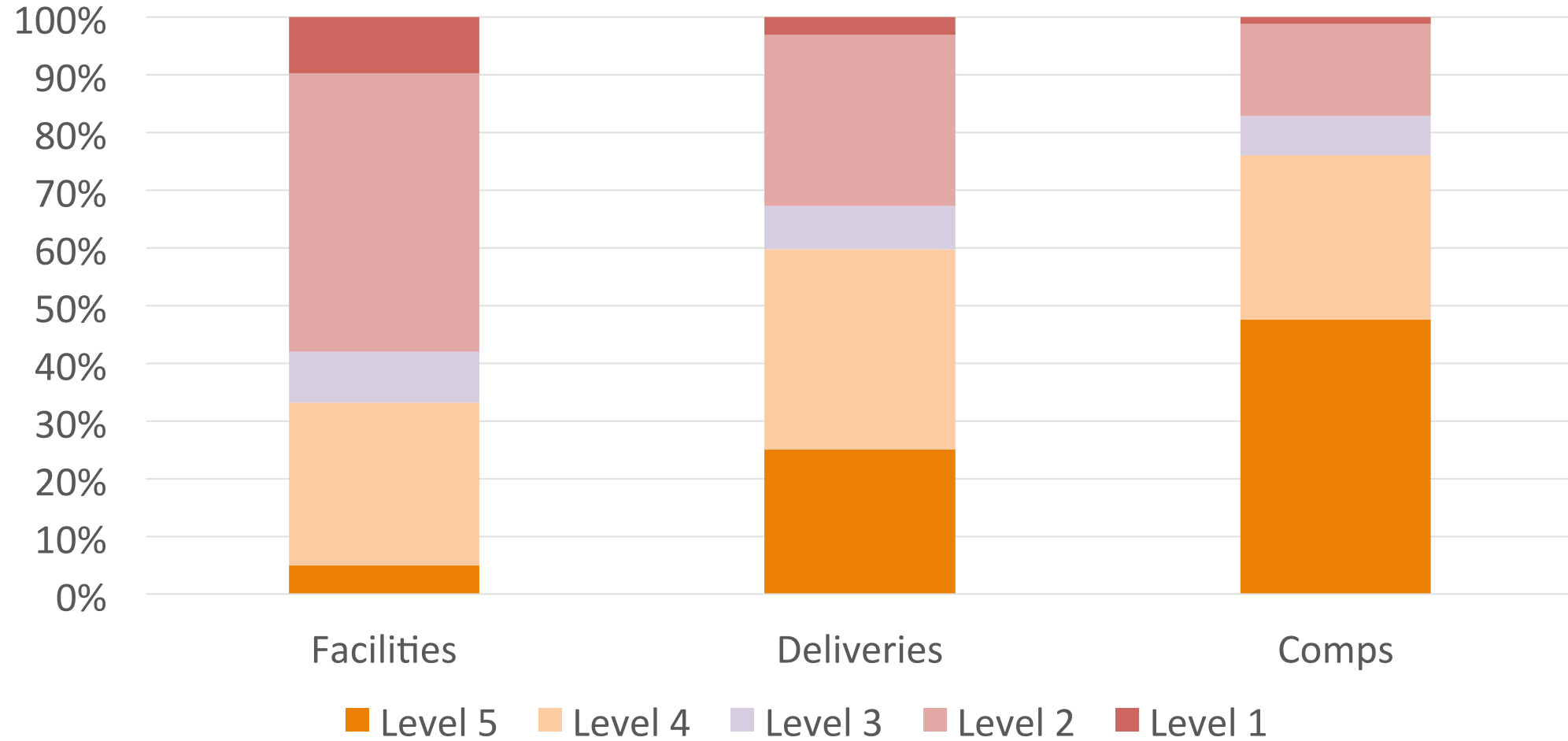


EXTRA SLIDES

# Facility Characteristics by Quality Level

Level	number of facilities	Monthly deliveries (mean)	Obstetric beds (mean)
Level 5	43	300.1	30.4
Level 4	259	71.7	9.0
Level 3	83	53.7	5.4
Level 2	459	35.0	4.3
Level 1	103	18.1	4.0

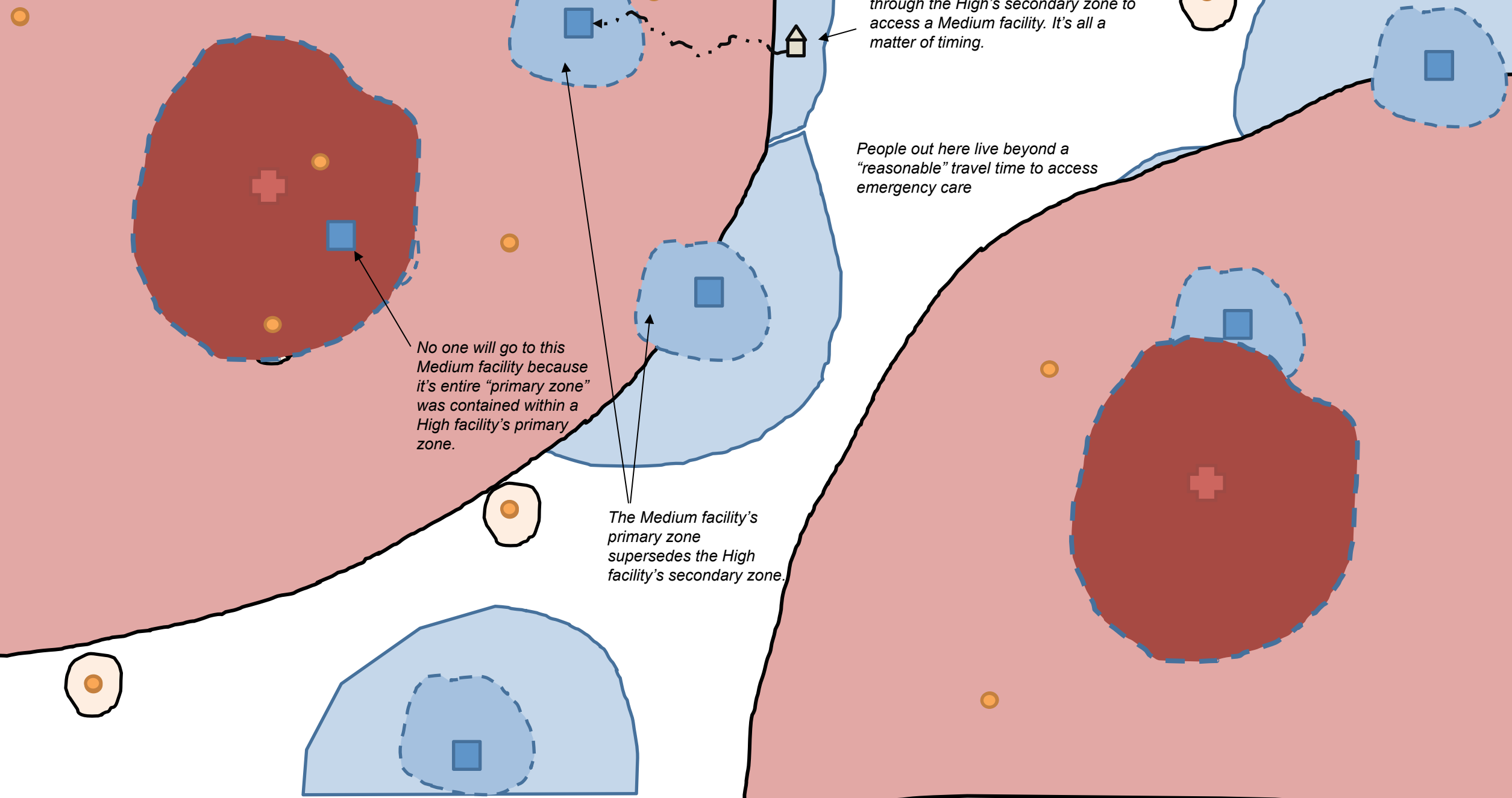
## Percent distribution of facilities, deliveries, and complications by quality level



# Time-bound catchment areas

<b>Level</b>	<b>Primary Zone Time Boundary (order of priority)</b>	<b>Secondary Zone Time Boundary (order of priority)</b>
Level 5 – Highest	0-2 hours (1)	2-5 hours (5)
Level 4 – High	0-2 hours (2)	2-5 hours (6)
Level 3 – Plus	0-1 hours (3)	1-3 hours (7)
Level 2 – Medium	0-1 hour (4)	1-3 hours (8)
Level 1 – Low	N/A	0-1 hours (9)

# Weighted Catchment Areas



A peculiar situation: people living in the Medium's secondary zone will go through the High's secondary zone to access a Medium facility. It's all a matter of timing.

People out here live beyond a "reasonable" travel time to access emergency care

No one will go to this Medium facility because it's entire "primary zone" was contained within a High facility's primary zone.

The Medium facility's primary zone supersedes the High facility's secondary zone.

# Data sources

## Facility data

Mozambique 2012 Assessment of Emergency Obstetric and Newborn Care

- National census, 946 facilities
- Used with permission from Ministério de Saúde de Moçambique (MISAU)

## Layers in the GIS

- Facility coordinates – MISAU, augmented via Google Maps. 80 not located.
- Population – WorldPop 2010
- Road network – OpenStreetMap 2014, substantially enhanced in OSM
- Land cover – GlobCover, accessed through European Space Agency
- Digital elevation model – SRTM version 3

# Excluded facilities (no geo coordinates)

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	Total facilities	excluded		included	
		n	%	n	%
Total	946	80	8.5	866	91.5
01NIASSA	77	5	6.5	72	93.5
02CABO DELGADO	101	10	9.9	91	90.1
03NAMPULA	119	13	10.9	106	89.1
04ZAMBEZIA	163	7	4.3	156	95.7
05TETE	70	3	4.3	67	95.7
06MANICA	78	10	12.8	68	87.2
07SOFALA	81	11	13.6	70	86.4
08INHAMBANE	104	11	10.6	93	89.4
09GAZA	92	6	6.5	86	93.5
10MAPUTO	49	4	8.2	45	91.8
11MAPUTO CIDADE	12	0	0.0	12	100.0

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