सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF HOUSING AND URBAN AFFAIRS

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Improving Emergency Medical Services through Planning Interventions in Urban Areas: A Case Study of Delhi

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WHAT ARE EMERGENCY MEDICAL SERVICES?

Emergency Medical Service (EMS) is a branch of emergency services dedicated to providing **out-of-hospital acute medical care** and/or **transport to definitive care.**

Source: (National Health Systems Resource Centre, 2010)

These time - sensitive medical services operate with the concept of **'Golden Hour'** which is the first hour after injury or onset of symptoms, during which *treatment is most effective.*

NEED OF THE STUDY

17 Deaths Per Minute (Indian Journal for Preventive & Social Medicine, 2023)

30% Mortality Due to Delay (The Lancet Journal, 2023)

55% of Cardiac Deaths In India (AIIMS and Niti Aayog, 2020)

Loss of Life Due to Delay in Healthcare

2% (89,155 Cr.) Budget Allocation (2023-24) For MoHFW (Sonali Randhawa, Sunil Nandraj, 2023)

<1% Funds Directed Towards Emergency Medical Services (The Lancet Journal, 2023)

1.4% decrease before and after Covid funding for EMS (AIIMS and Niti Aayog, 2020)

Financial Support in Healthcare for Emergency Medical Services

Only 34% of the ambulance were assisted by paramedics (AIIMS & Niti Aayog, 2020)

Only 2% of the total govt. hospitals are district hospitals (National Health Profile 2022)

Only 55% hospitals have access roads for ambulance (AIIMS & Niti Aayog, 2020)

Infrastructural Planning and Distribution for Emergency Medical Services

NO allocation rationales for ALS and BLS distribution (International Journal for Multidisciplinary Research, 2023)

Irrational location criteria's for PHC's and stations

Lack of a standard Pan-India network for ambulances

Gaps in the Current Practice

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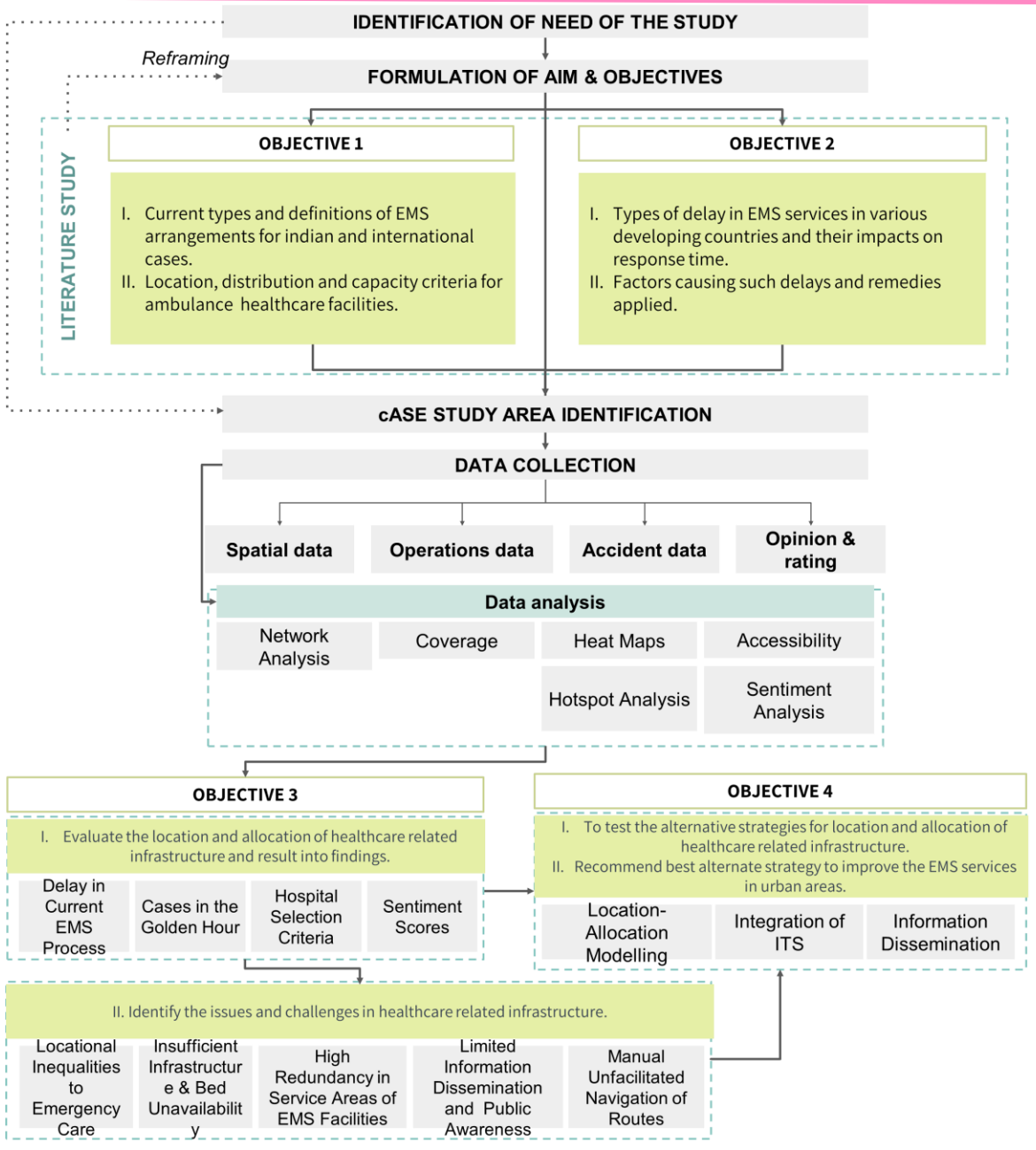
FINDINGS FROM LITERATURE REVIEW

Urban aspects contributing to delay

Location & allocation of ambulance services	Location of Healthcare Facilities
By capacity	**By typology**
Inadequate distribution of ALS and BLS according to the needs of the population and empirical data on emergencies.	Relocating to different hospital due to technical inadequacies according to the emergency.
By type of information	**By hierarchy of facility**
Information in India is currently stored as descriptions instead of geo-coordinates.	Relocating to far off trauma centers instead of lower order hospitals that are in proximity.
Location of ambulance stations are currently largely based on **parking space availability and demand allocation.**	Locations of public healthcare facilities are currently primarily bound by **available land and proximity to residential use.**

Routes connecting these two locations

STUDY METHODOLOGY



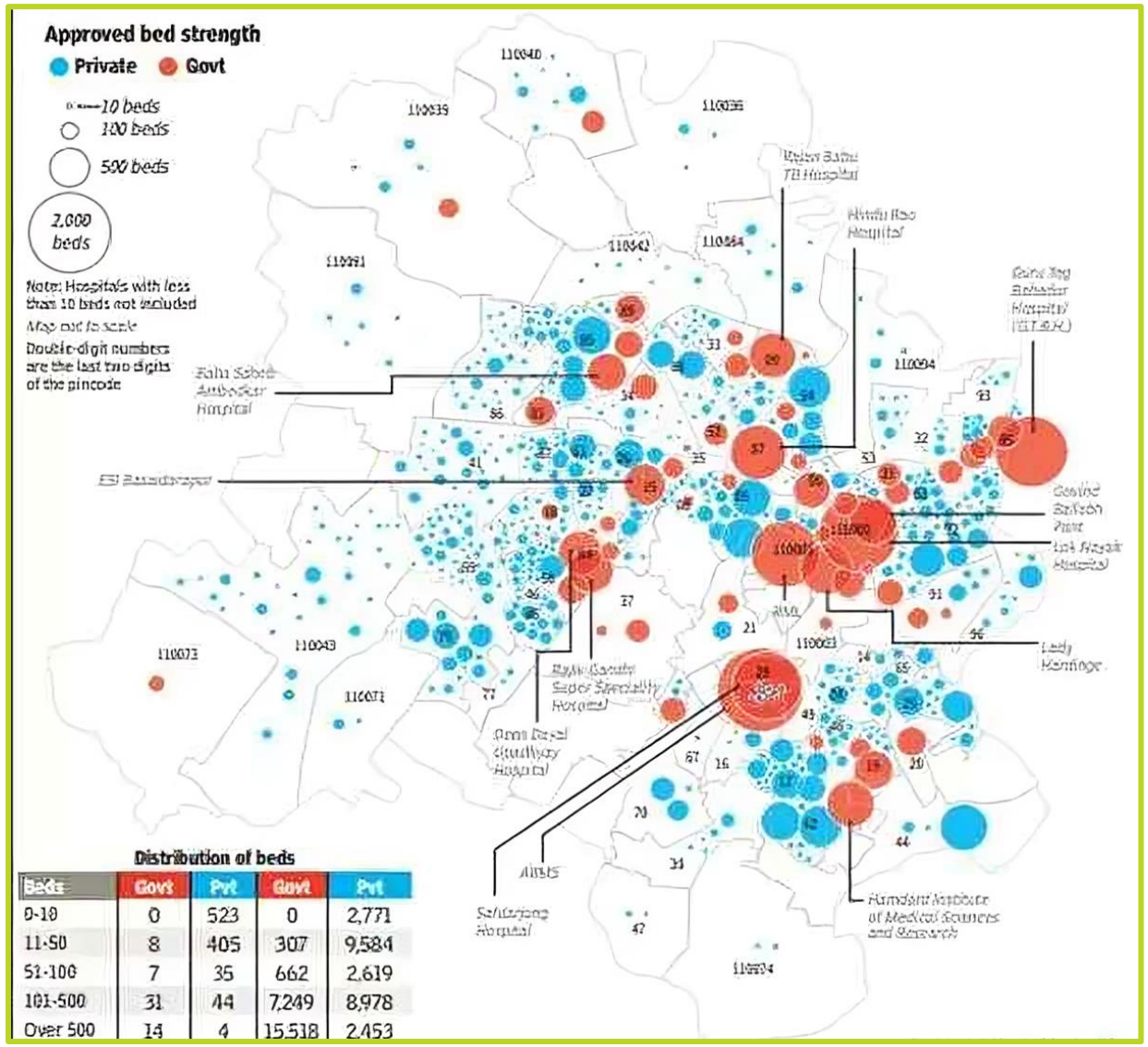
CASE STUDY AREA PROFILE: DELHI

AREA SELECTION CRITERIA

Delhi accounts for the highest number of traffic accidents in India.

Delhi is a major healthcare destination (2.5% of all tertiary healthcare in the country).

Approx. 2 Ambulances per 10 sq. km. and 1 per 1.37 Lakh population is available in Delhi.



Beds	Govt	Pvt	Govt	Pvt
0-10	0	523	0	2,771
11-50	8	405	307	9,584
51-100	7	35	662	2,619
101-500	31	44	7,249	8,978
Over 500	14	4	15,518	2,453

Delhi Master Plans

1962 | At least one hospital in each planning division for specialised facilities. **No location criteria.**

2001 | 6-Tier system introduced with scale specification and plot area. **No location criteria.**

2021 | 4 Categories of Hospitals (Bed-wise) but **no location criteria mentioned**.

	Advanced Life Support (ALS)	Basic Life Support (BLS)	Passenger Transport Ambulance (PTA)
Existing	24	124	92
Standards (WHO)	1 per 5 Lakh	1 per 1 Lakh	
Requirement	34	168	
GAP	10	44	

No. of emergency cases (24 hours) | 2259

No. of deaths (24 hours) | 23.2%

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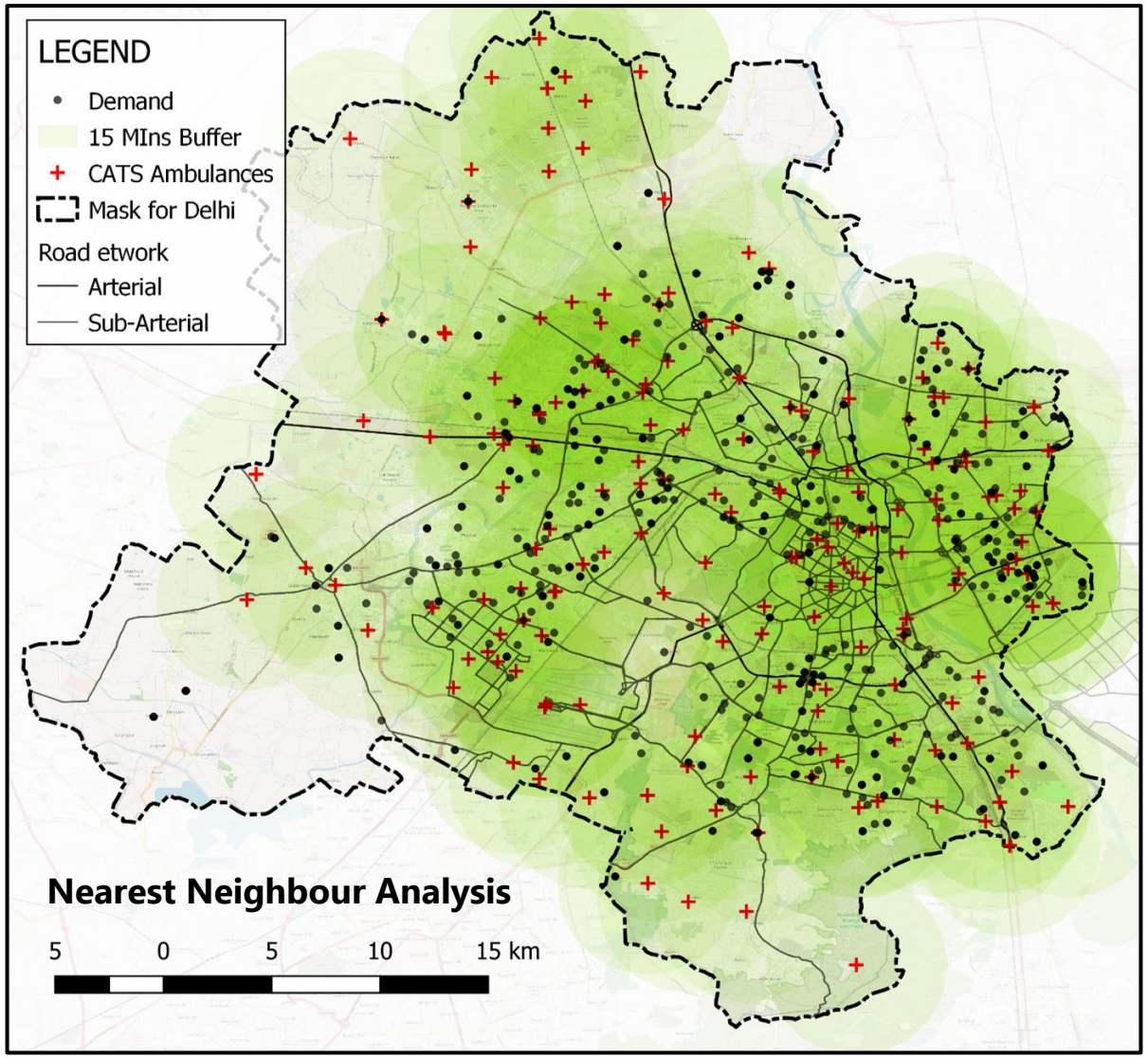
COVERAGE OF DEMAND WITHIN IDEAL TARGET TIME



Demand Coverage in 15 Mins (Target time) at 18 KMPH Speed	Demand Covered	99%
	Demand Uncovered	~1%

2.79% Cases	Below 60 Mins (Ideal Case)			
	Call to Dispatch Time	Dispatch to At-Scene Time	Pick up to Hospital Arrival Time	Duration (In Minutes)
Average	3.01	11.14	26.81	47.94

97.21% Cases	Above 60 Mins (Average Case)			
	Call to Dispatch Time	Dispatch to At-Scene Time	Pick up to Hospital Arrival Time	Duration (In Minutes)
Average	3.36	15.81	102.87	141.60

- High number of non-critical cases (e.i. Dialysis, deliveries, fractures, etc.) also increase the average time of the zones.
- **High number of calls and low average time indicates zones with high critical calls.**

- Limited ALS ambulances reflect that over **93% of cardiac related cases are transported by either BLS or PTA.**
- A correlation between number of ambulance stations and response time reflects a negative but weak coefficient.

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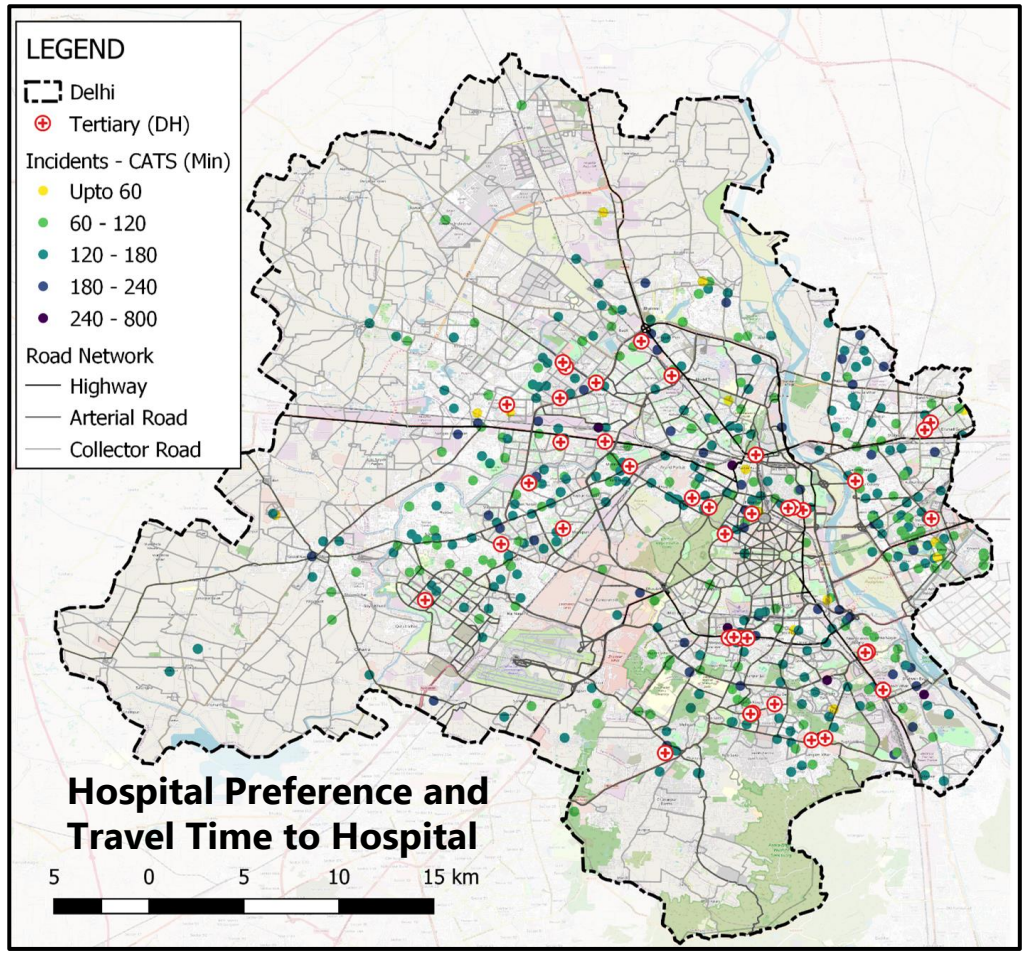
COVERAGE OF DEMAND WITHIN IDEAL TARGET TIME



					Hospital Alt 1		Hospital Alt 2		Hospital Alt 3	
	Origin	Actual Hospital	Actual Time	Reason	Name	Time (Mins)	Name	Time (Mins)	Name	Time (Mins)
1	University College Of Medical Sciences East Delhi	RML Hospital	40.48	Interhospital Transfer	GB Pant Hospital	32.67	Guru Nanak Eye Hospital	33.55		
2	Ujwa South West Delhi	Dduh Hari Nagar	67.98	Breathing Difficulty	Mata Chanan Devi Hospital	55.50	Venkateshwar Hospital	43.92		
3	Conductor Colony North Delhi	Safdarjung Hospital Ansari Nagar	57.13	Others	Fortis SS Hospital	57.78	Max SS Hospital	47.15	St. Stephens Hospital	34.05
5	Malik Pur Central Delhi	Safdarjung Hospital Ansari Nagar	67.13	Interhospital Transfer	Venkateshwar Hospital	67.13	Mata Chanan Devi Hospital, Chanakyapuri	62.25	Deen Dayal Upadhyay Hospital	73.00

Delay increased due to:

- **Increase in waiting time** for ambulance availability.
- **Public Preference over nearest facility**

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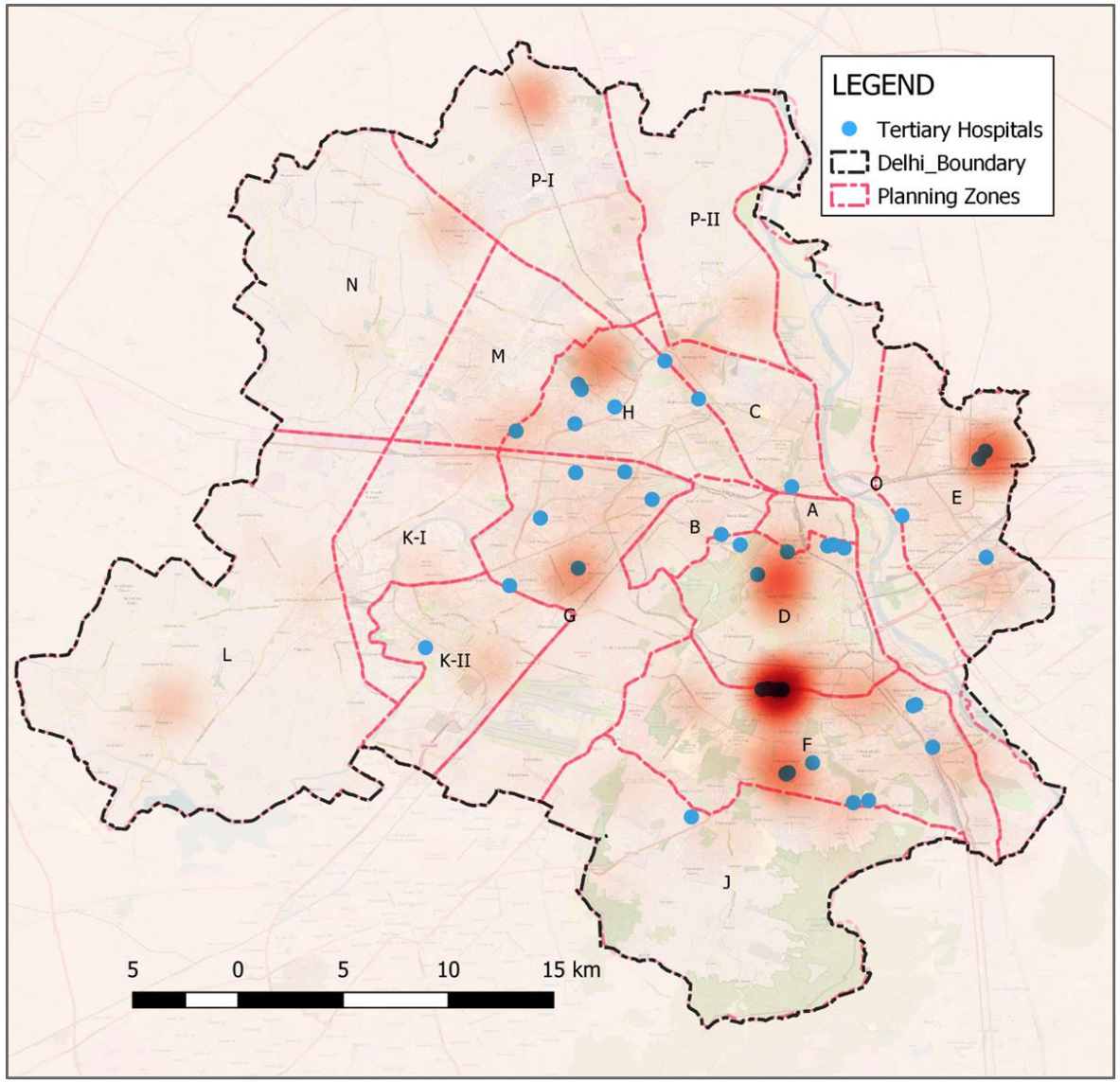
SITE SELECTED FOR ZONAL STUDY: ZONE F



Step 1 | Call Volume and Hospital Distribution

	Top 5 Demand Zones				
Zones	**D**	**E**	**F**	**G**	**H**
No. of Calls	120	235	154	121	88
No. of Tertiary Hospitals	6	4	13	6	7

Step 2 | Response Time - Zonal Analysis

Zones	**Average Time**	Min. Time	**Median Time**	Max. Time
D	149.70	47.65	145.56	704.27
E	128.04	34.9	127.15	245.2
F	143.48	18.72	144.72	334.5
G	148.01	64.83	148.38	239.43
H	139.94	41.52	138.9	271

Step 3 | Emergency type and distribution

Category of Emergency	Zone D	**Zone F**	Zone G
Traumatic Emergencies	41	**60**	30
Medical Emergencies	15	**25**	16
Interhospital Transfers	21	**19**	21
Other Emergencies	43	**50**	54
Total	77	**104**	67

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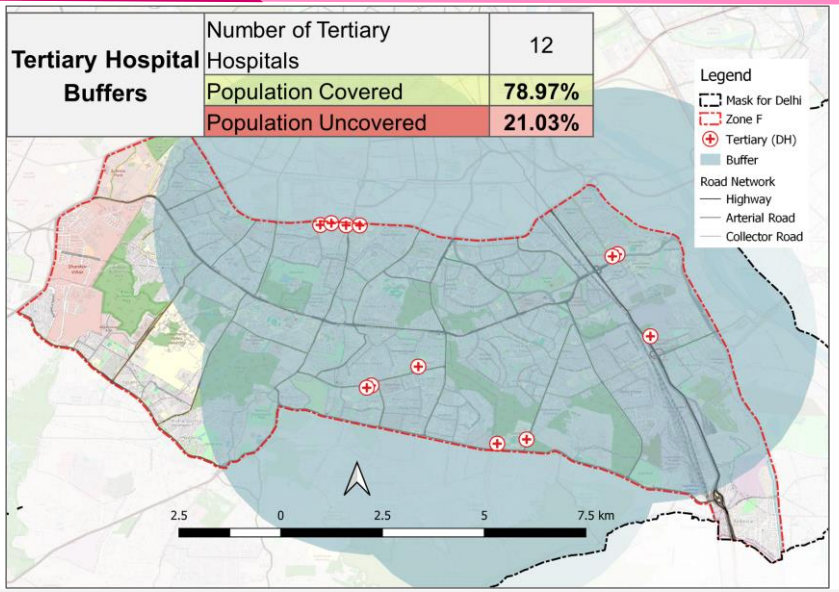
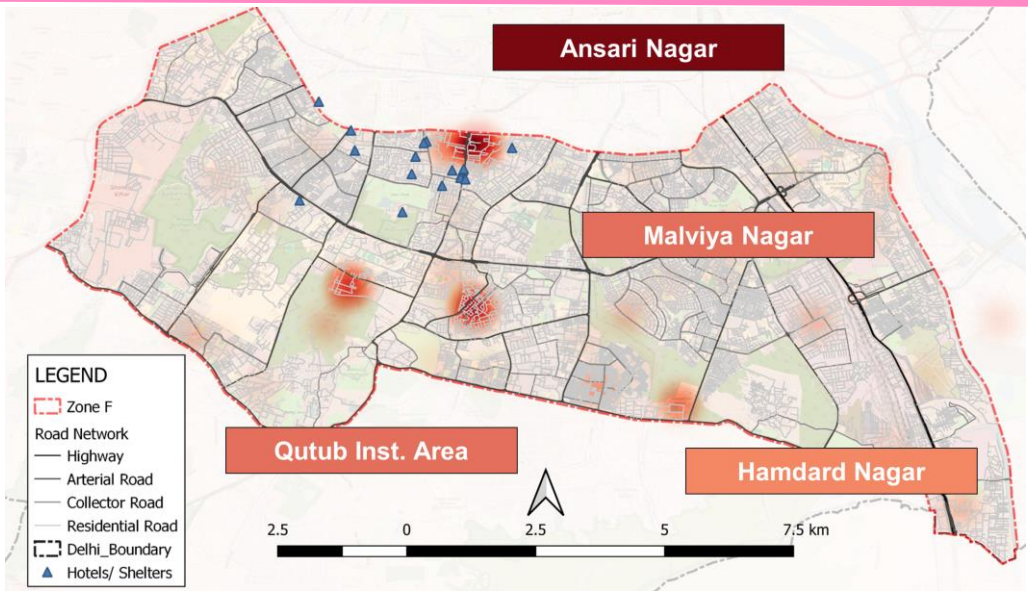
EXISTING SITUATION OF EMS IN ZONE F

Tertiary Hospital Buffers		
	Number of Tertiary Hospitals	12
	Population Covered	78.97%
	Population Uncovered	21.03%





SELECTED HOSPITAL PROFILE

Selection criteria	Spatial coverage	Operation type	Emergency wing availability


PT. MADAN MOHAN MALVIYA


SAFDARJUNG

INDRAPRASTHA APOLLO

HOLY FAMILY

TRITON


MAX SUPER SPECIALITY

Zone	Total No. of Calls	<1 Hour	> 1 Hour	Min. Response Time	Max. Response Time	Average Response Time
F	154	6	148	18.72	334.5	143.48

Call to Dispatch Time	Dispatch to At Scene Time	Pick Up to Hospital Arrival Time	Time to Reach the Hospital
3.75 Mins	14.06 Mins	**101.70 Mins**	119.51 Mins

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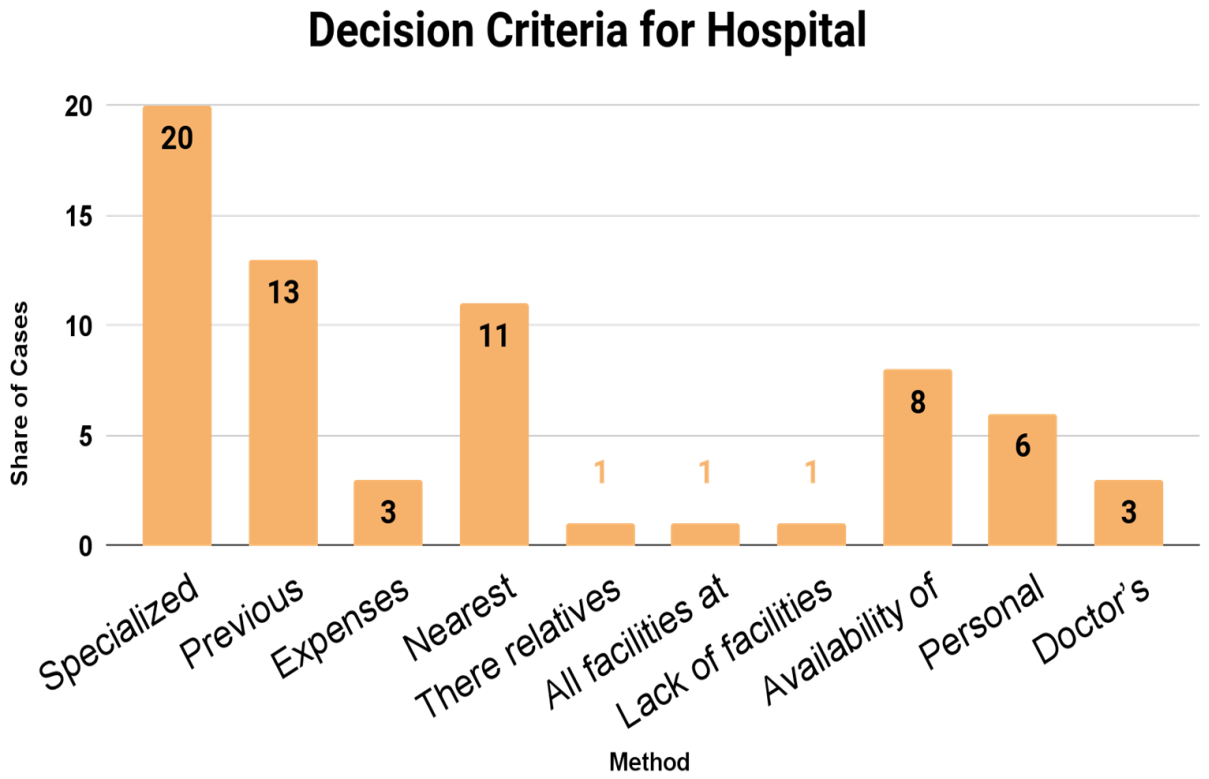
FINDINGS FROM EMS USER SURVEY

TO THE INCIDENT SITE							
	<10 Mins	15-20 Mins	25-35 Mins	35-45 Mins	1 Hour	> 1 Hour	Total
Night	1	2	0	1	1	4	9
Morning	2	2	0	0	0	4	8
Afternoon	3	2	0	2	0	7	**14**
Evening	5	1	0	0	0	6	12
Total	11	7	0	3	1	**21**	
TO THE HOSPITAL							
	<10 Mins	15-20 Mins	25-35 Mins	35-45 Mins	1 Hour	> 1 Hour	Total
Night	5	2	0	0	3	7	17
Morning	3	3	2	1	2	9	20
Afternoon	9	2	4	4	1	19	**39**
Evening	4	2	1	0	1	7	15
Total	21	9	7	5	7	**42**	



Contributors for delay according to users:

- **49.2% respondents don't believe they have specialised emergency facilities in their nearest hospitals.**

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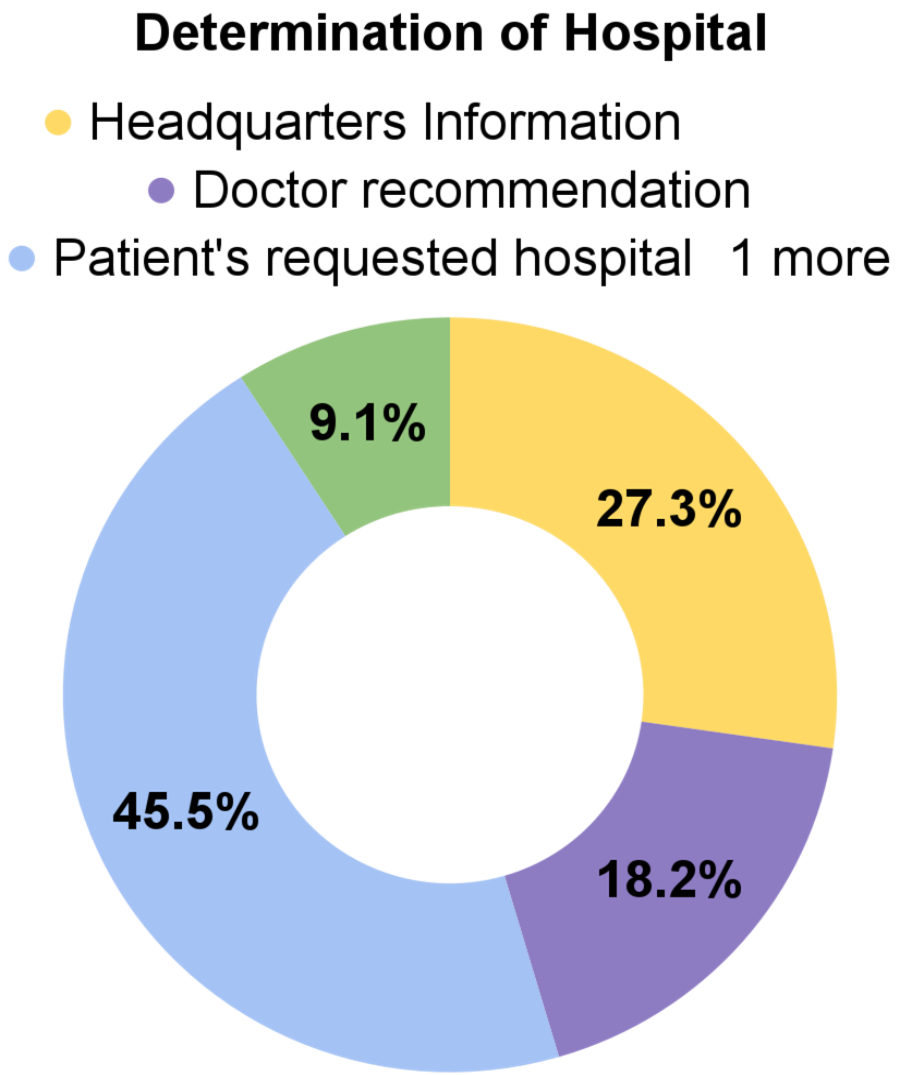
FINDINGS FROM AMBULANCE OPERATOR SURVEY



30% of all deaths are caused by delay,
directly or indirectly

~ 87.5% of the respondents

Contributors for delay:

- **63.7% of the cases are not taken to the nearest emergency facility.**
- ALS facilities are largely under private operators.

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FINDINGS FROM HOSPITAL MANAGEMENT SURVEY

An avg. of **5-10 cases** are **declared dead on arrival everyday,** by ambulance.

~ 75% of the respondents

An average of **3-6 cases die in the emergency department** itself.

~ 68% of the respondents

Hospital	Avg. No. of Cases (24 Hours)	Bed Turnover Rate(Est.)	Emergency Bed Count	Total Beds	Existing Bed Share
Safdarjung Emergency Dpt.	50 - 100	0.233	429	1531	28.02%
Pt Madan Mohan Malviya Hospital	100	10	10	150	6.67%
Max Super Speciality	100	3.125	32	545	5.87%
Triton Hospital	10	10	1	68	1.47%
Holy Family Hospital	50	1.6667	30	345	8.70%
AIIMS Hospital	155	1.026	151	3669	4.12%
Apollo Hospital	-	-	20	710	2.39%

Contributors for delay:

- **Only 4/7 facilities have over 5% of the beds allocated to trauma services.**

★ **Moderate-High bed turnover rates in 4/6** facilities reflects **unavailability of beds and bottlenecks in the patient flow.**

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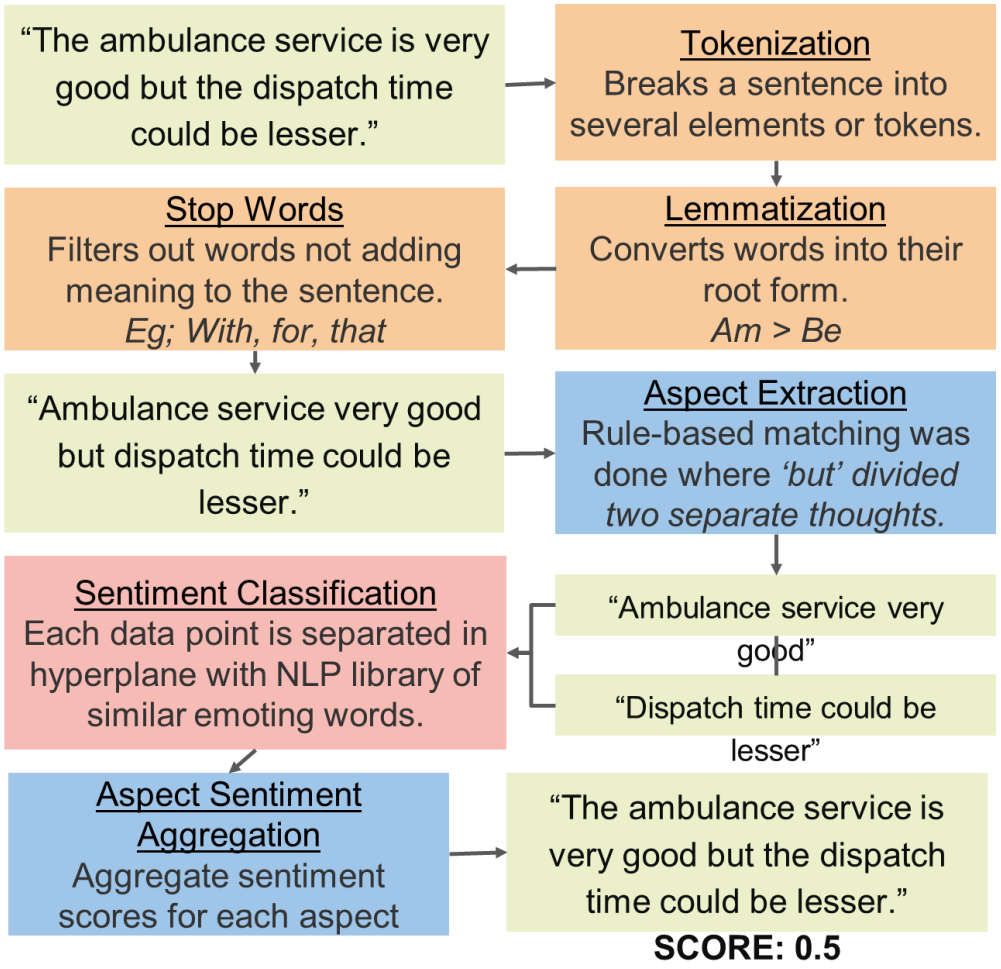
NATURAL LANGUAGE PROCESSING (NLP) ASPECT-BASED SENTIMENT ANALYSIS

Sentiment analysis is the process of **analyzing digital text** to determine if the **emotional tone** of the message is positive, negative, or neutral and understand the **respondent's attitude towards a topic.**



Preview Comments	Sentiment Score
The ambulance service is very good but the dispatch time could be lesser	0.5
The ambulance service is good and the behavior of staff is also very polite	0.8
Paramedics or doctor was absent in the ambulance	-0.4
More emergency ambulance should be available	0.4
"The Ambulance Service was fine, but they took too much time on call to send the Ambulance"	-0.5
The treatment is started very late due to the many questions they ask during call time	-0.4

Age	Average Score
18-35	-0.06
35-50	-0.16
50 and Above	-0.31

Gender	Average Score
Male	-0.1
Female	-0.3

Average Score	-0.2
Median Score	-0.4
Mode Score	-0.7

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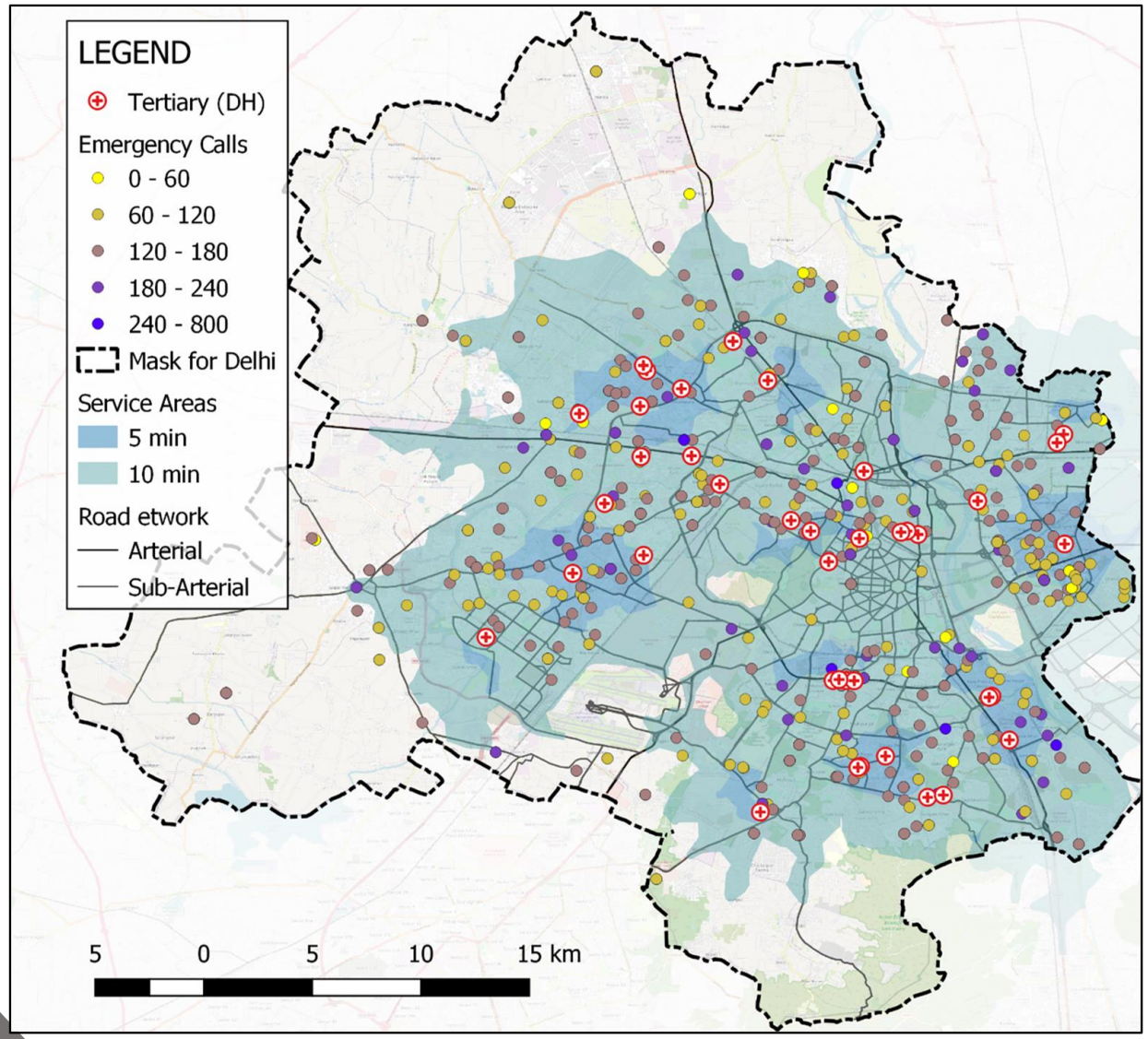
SUMMARY OF ANALYSIS

	CITY SCALE : DELHI	ZONAL SCALE : F
USER	● Critical cases with availability of ALS: **7% cases** ● Zones D,E & F are the demand zones covering **45.9%** of all daily cases.	● Public perception and sentiments regarding EMS : **- 7 sentiment score** ● Cases >1 Hour to reach hospital: **48.8%** ● Major Hospital Selection Criteria: ○ Specialisation (**29.8%**) ○ Nearest Facility (**16.4%**)
AMBULANCE	● Cases with more than 60 mins response time : **97.21% cases** ● Average time to hospital : **1 hr 30 minutes.** ● People opting for public emergency facilities : **29.79%** ● Overlapping of ambulance service areas: **WRITE HERE**	● Cases taken to nearest hospital : **9.1%** ● **30%** of all deaths in ambulance are caused by delay ● Predominant age-group : 18-35 (**60%**) Freshers ● Gaps in Infrastructure: **4 ALS** and only **19 BLS** ● Average response time for Zone : 143 Mins
HEALTHCARE MANAGEMENT	● No location criteria rationales in master plans. ● Tertiary hospitals on low Levels of Service : **57.1% cases** ● Tertiary Hospitals on Major Roads (Arterials): **13%** ● Service area extent under 15 Mins : **28.82%**	● Cases declared dead on arrival : **5-10 daily** ● **3/7** Surveyed Hospitals with more than 5% of Emergency Beds ● **63.67%** of all cases directed to Safdarjung. ● Average 100 emergency cases daily.

FINDINGS & ISSUES

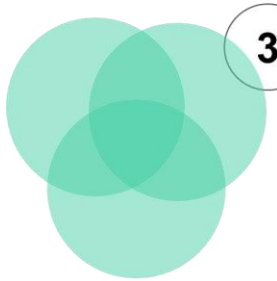


Locational Inequalities to Emergency Care

Clustering of Facilities

Insufficient Infrastructure & Bed Unavailability

High Interhospital Transfers



3 **High Redundancy in Service Areas of EMS Facilities**

Underserved Areas

4 **Limited Information Dissemination and Public Awareness**

Deprioritizing Nearest Facility

5 **Manual Unfacilitated Navigation of Routes**

High Count of Stoppages in Traffic

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RECOMMENDATION 1 – Promoting Lower Level Trauma Centers

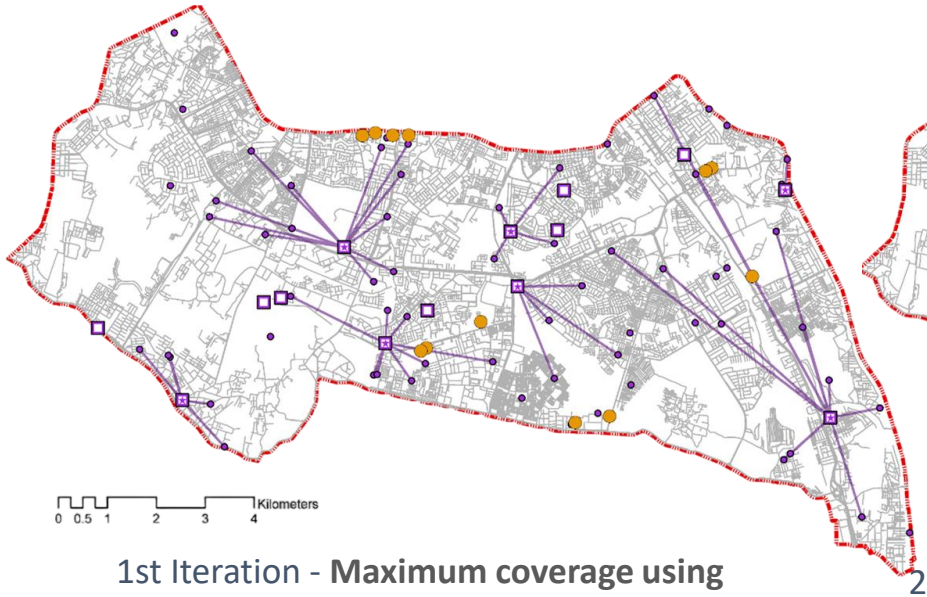
TERTIARY HOSPITALS

2041 Forecasted Population (Master Plan 2041) - Zone F	33.9 Lakhs
District Hospital (IPHS for 2 Lakh) Requirement	**17**
District Hospitals Current Count	**12**

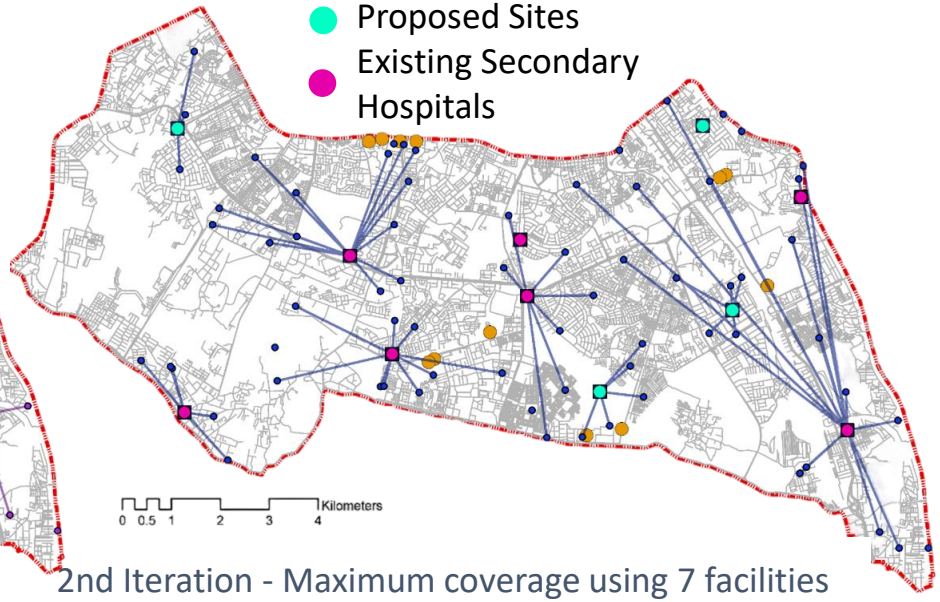
STUDY BASED SITE SELECTION CRITERIA

Arterial Roads	Access controlled, less stoppages & traffic
Density of Tertiary Hospitals to be Maintained	Decreases redundancy & focuses on equitable distribution
Coverage of First Referral Units (FRUs)	Covering Low-Level trauma Centers (FRUs) will decrease burden on tertiary centers.
LOS should be A to C	Access time decreases and improves response time

LOWER LEVEL TRAUMA CENTERS (FRU)



1st Iteration - **Maximum coverage using 7/14 facilities**



2nd Iteration - Maximum coverage using 7 facilities from 1st iteration and 4 new locations.
Maximum coverage using 8/11

Zone	Total Number of Calls	Calls within Golden Hour	Calls above Golden Hour
F	158	1.95%	96.10%
ITERATIONS			
F*	158	76.5%	23.5%
F**	158	147 **(93.04%)**	11 **(6.96%)**

F* Iteration - Maximum coverage from existing facilities
F** Iteration - After proposal of 4 new locations

	Calls within Golden Hour	Calls over Golden Hour
Delhi Currently	2.79%	97.21%
Change Ratio		**0.91**
After Proposal	5.32%	91.89%

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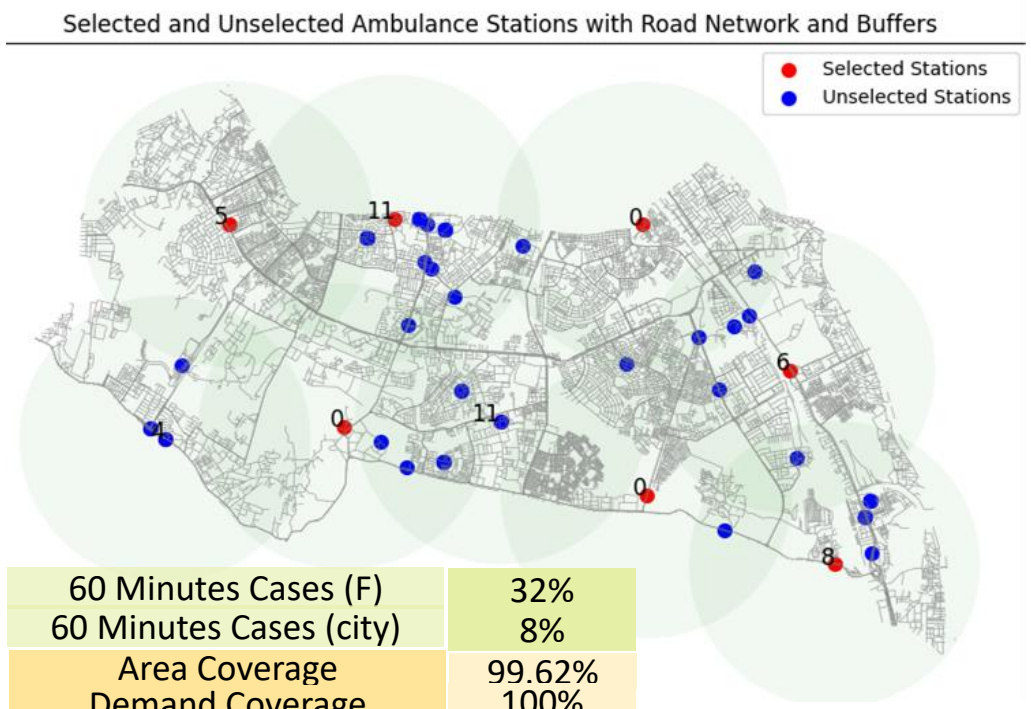
RECOMMENDATION 2 & 3

AMBULANCE ALLOCATION ON DEMAND DENSITY TRENDS

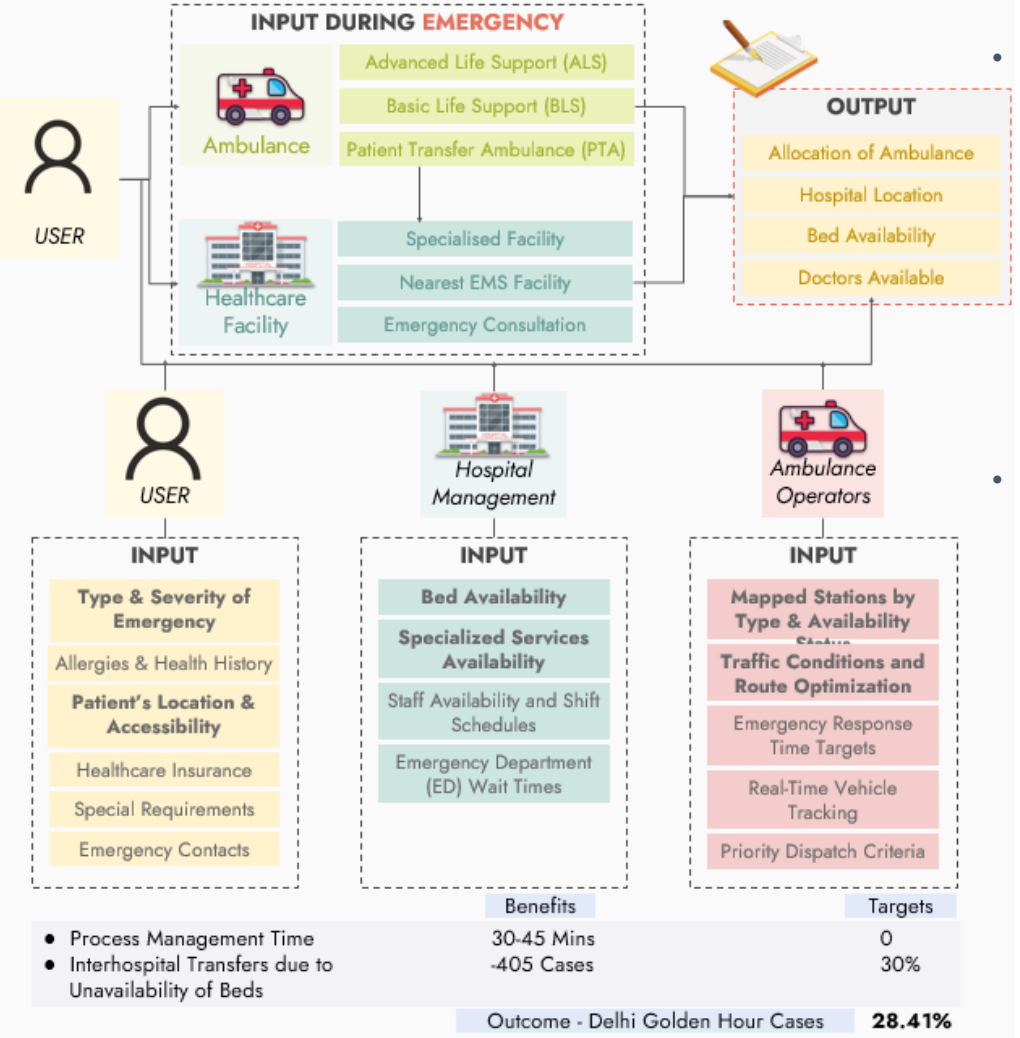
Iterative Ambulance Station Location Process for Zonal Plan Integrations

Identification of demand clusters and critical zones → Demand density within 10 mins buffer of the station → 2:1 (Demand:Ambulance) to be targeted acc. to demand trends → Re-allocation of ambulances according to shift in demand



60 Minutes Cases (F)	32%
60 Minutes Cases (city)	8%
Area Coverage	99.62%
Demand Coverage	100%

PROMOTING MEDISYNC WITH LINKING TO ABHA



- Bridging the gap between stakeholders through **adequate information transfer** will allow users to make an informed choice and also reduce burden on over-pressurised hospitals.
- MEDISYNC will be facilitating real-time communication and coordination between users, ambulances, and healthcare management, it will **streamline the response process, reducing delays and potentially saving lives in critical situations.**

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RECOMMENDATION 4 & 5 – Green Corridors and ITS Integration

GREEN CORRIDORS | A special route that ensures safe and quicker transfer of **organs** through a **manually operated, traffic-free route.**

EXISTING OPERATIONAL MECHANISM

- Hospital gets in touch with the police commissioners office (2-4 hours before harvest)
- Traffic police chart the fastest & most navigable route.
- Officers at various points to blockade roads, manage traffic and prevent red lights
- Motorcade of 4-5 vehicles sent to destination (police gypsies & addtnl. ambulance.)

INTEGRATING CHANGES FOR EMS

- Immediate cases like cardiac cases, brain injury or hemorrhage (ALS) to be prioritised with transplant cases.
- Identification of shortest routes to be automated and incorporated into the signal synchronised mechanism.
- Officers aid will be required at collector-sub-arterial routes and lesser requirement of motorcade.

BASIS OF ROUTE SELECTION

Arterial Roads & Highways	Locations of Tert. Trauma Centers	Locations of Secondary Trauma Centers	Maximum spacing between intersection

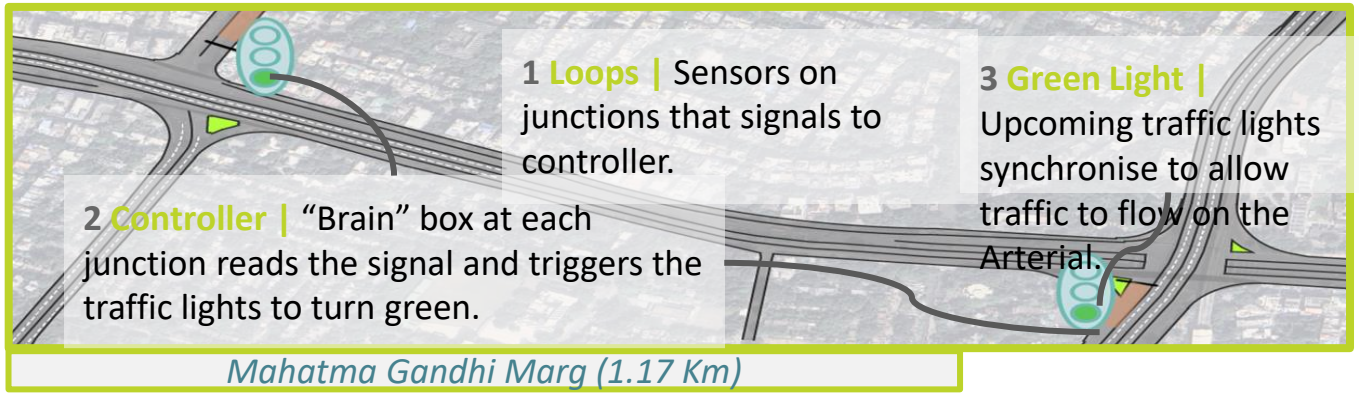
SIGNAL PRIORITISATION - JUNCTION LEVEL INTERVENTIONS

FUNCTION NORMAL CONDITIONS

1. Sensors on junctions that signals to controller, prioritising vehicles on arterial roads.
2. "Brain" box at each junction reads the signal and triggers the traffic lights to turn green.
3. Upcoming traffic lights synchronise to allow traffic to flow on the Arterial.

FUNCTION DURING EMERGENCY

- Special tags to be installed in ALS ambulances. Sensors will prioritise them over traffic, under 200m-1.5km.
- "Brain" box triggers the traffic lights to turn green and VMS showcases an alert on screen mounted on the lights.
- Shortest route is identified by the system or manually updated by the traffic management center.
- Signal synchronisation is paired with shortest path and informed to the driver.



Mahatma Gandhi Marg (1.17 Km)

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THANK YOU

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