



Emergency Healthcare in Rural Areas[©]

It is customary for the Swamiji to take the usual rounds through the dormitory of the ashram after the morning prayers to inquire the well being of the residents before he reaches his office. The Swamiji always felt that spending 30 minutes with the ashram inmates helped him initiate several actions pertaining to certain operational issues if any for the day. However, the Swamiji skipped the routine on that day and instead chose to proceed directly to his office room. As he walked past the meditation room, a glance at his face would have suggested that he was engrossed in deep thought.

The Swamiji is meeting with the young disciple who has made some study pertaining to the healthcare problems in and around the area where the mutt is located. Clearly, he was anxious to know more about the problems that the villagers are going through in getting quality healthcare. He was deeply engrossed in the issue and several questions ran in his mind. Was it true that there have been several deaths of the patients in his area due to non-availability of timely hospital facilities? What is the role of the mutt in mitigating this problem? Has the deployment of Ambulance by the mutt made any difference? "Pranams Guru Maharaj", the voice of his young disciple broke his stream of thoughts and brought him back to the reality of his office room.

Rural healthcare

Providing quality health care to rural population is an important, albeit, less addressed issue in developing countries such as India. Several healthcare indicators such as number of beds per 1000 population, number of qualified medical and para-medical staff per 1000 population, and the quality of other medical infrastructure point to gross inadequacies and the need to address them in multiple ways. India is no exception to these trends. Exhibit 1 provides some indicators of the status of healthcare in India.

Although there has been a general increase in investment in public health care in India in recent years, the requirements far outstrip the demand. The reasons for such a slow growth in infrastructure are not far fetched. Developing healthcare infrastructure in rural areas has been the responsibility of mainly the government. However, grossly inadequate budgetary provisions coupled with poor application of available funds, inappropriate incentive and management control systems and lack of customer orientation have all resulted in wasteful expenditure and ineffective capacity build up in the sector. On the other hand, private investment in augmenting healthcare infrastructure in rural areas do not simply happen due to lack of volumes and low expected returns on investment. The only other alternative is for Non-Governmental Organisations (NGOs) to complement the government initiatives in addressing the health issues in rural areas. In India the role of NGOs is significant and growing.

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Due to poor healthcare infrastructure in rural areas it is inevitable for the rural population to access medical facilities in nearby urban areas. Ironically, this becomes extremely important in case of serious accidents resulting in trauma since specialized facilities are not available in the rural areas. This for instance would mean visiting a hospital in town panchayats and/or district headquarters. Typically to access such a facility the patients in the rural areas may have to travel at least 10 – 12 kilometres. However accessing the urban infrastructure has been challenging for the rural population for a few reasons. First is the issue of connectivity. The connectivity of rural areas to nearby towns and district headquarters is an area of great concern. Often, several villages do not have all weather roads. In several cases, absence of bridges and causeways over canals and small rivers will require the patients to take a circuitous route to reach a nearby hospital. The second issue is the availability of adequate and timely transportation facilities including ambulances. This is especially important in accidents resulting in severe injuries and high trauma. Again government agencies have not been able to provide adequate ambulance facilities. Fortunately, providing ambulance services is less challenging as the investment, skill and manpower resources required is far less than setting up a hospital for the rural population. Therefore, it is not uncommon for several NGOs to provide ambulance services.

The Krishna mutt in rural South Bihar

The Krishna mutt operates in the rural area of South Bihar, located about 60 kilometers northwest of Jamshedpur (it is relevant to note that Jamshedpur is no longer part of Bihar but that of Jharkhand).. By virtue of its location, the mutt is in a position to cater to several welfare requirements of about 74 villages. While imparting religious and cultural practices among the village community is the main activity of the mutt, it has also traditionally played a dominant role in addressing various developmental and welfare issues of the villages in the surrounding areas. The *Swamiji* commands a certain respect among the district administration and utilizes this advantage that he enjoys to obtain certain benefits for the common good of the villagers. Among the important priorities of the mutt are striving to provide value based education to the children in the villages, enabling them with vocational training that are likely to fetch some economic livelihood and addressing health related issues.

Typical of the situation in rural parts of India, the 74 villages do not have adequate healthcare facilities. Limited infrastructure (in the form of four government public health systems) is available for use of the population in these villages. Each government hospital has ten beds. The other facilities available in these hospitals are much limited compared to a similar hospital in a big city or the district headquarters. However, visiting such hospitals and receiving first aid immediate medical attention is valuable in cases involving major injuries. In addition, there are a few private hospitals available in the area. Generally, private hospitals are more expensive than the public hospitals. However, they tend to be more responsive and better equipped than the government hospitals. Due to the economic status of the villagers, often a vast majority of the patients prefer to visit the government hospital and choose the

private ones only when there is no capacity available in government hospitals or the situation is extraordinarily critical.

The villages could be broadly classified under eight different zones from a geographical viewpoint. While some clusters of villages have well connected roads, some others do not have good roads. Exhibit 2 shows the location of the villages, the four government hospitals in the cluster, and the mutt and the nature of connectivity available. Exhibit 3 has the distance between the villages and the hospitals and the mutt. All the zones are well connected with Mutt except zones Z7 and Z8. Hence the average speed of an ambulance is 30 Kilometres per hour (Kmph) for other zones and 20 Kmph for zones Z7 and Z8. All the hospitals are located roughly at a distance of about 12 Kms from the mutt.

Ambulance Deployment

Consistent with its objective of improving the status of healthcare, the mutt purchased *two ambulances* for use by the population in the 74 villages. The ambulances are stationed in the mutt premises. The villagers from the eight zones can request for ambulances whenever any medical emergency situation arises. Whenever a request for ambulance is made, the mutt will note down the location details and send an idle ambulance to the point of request as soon as it is available. After servicing the request the ambulance returns back to the premises and awaits its next service call.

Commenting on the purchase of ambulances, the *Swamiji* had the following to say:

As we all know, rural areas do not have adequate number of beds and hospital facilities. We wanted to address this problem and improve the state of affairs in our area. We could have done it in two ways. One method is to build hospitals in our area. Investing on hospital facilities is resource intensive and expensive. Moreover, it needs specialized skills to maintain and run the whole affair. Currently we are not in a position to pursue this alternative.

Whenever accidents occur, it is not uncommon to fetch ambulances from far off places and transport the victims to hospitals equipped with emergency care facilities. Therefore, the other alternative is to invest on ambulances and help reach the patients to the hospitals in time. I felt that it is a worthwhile effort on the mutt to station some ambulances in the mutt premises and make it available to the villagers. I believed that in the short run it will make a significant improvement in the state of affairs.

Occurrence of accidents is due to several reasons, but is often attributed to work related events resulting in grave injuries. Often time the affected person would have got injured at the work place due to risky work practices that he/she adopted. Based on the past records, it was found that the pattern in which accidents occur follows a Poisson distribution. The mean inter-arrival time is negative exponentially distributed with a mean of 60 minutes. Historically, zones Z3 and Z5 are found to be

more accident prone, although the reasons are unknown. The zone-wise distribution of the accident frequency is given in Exhibit 4.

The issue of poor connectivity between the villages and the hospital is not a serious issue in the case of outpatient and non-trauma cases. However, in cases involving serious accidents and grave injuries leading to trauma, delays in reaching the hospital can prove to be fatal. Therefore, severity of the accidents determines how soon the injured patient must obtain clinical assistance. Higher the severity, greater is the need to reach a hospital.

Based on a study of such traumatic cases in the target area under consideration some understanding of the impact of delay was made. The analysis using past records revealed some relationship between the delay and the status of the accident victims. Exhibit 5 gives the probability distribution of death with respect to the elapsed time after the accident. According to one field researcher involved in the project,

Clearly, in all the cases that we have analyzed, the death of the victim depended on the elapsed time after the accident. The first twenty minutes in my opinion is the “golden time” when we are almost certain to save the patient. At the other extreme however, almost in all the cases death has occurred after 2 hours from the time of the accident. Therefore, the critical question is what is the turnaround time¹ that we can provide to the villagers?

The duration a sick person occupies the bed obviously varies with the intensity of the injury. Sometimes the injury may be heavy causing the patient to stay for a longer time in the hospital. The time the patients occupy the bed was found to follow a normal distribution with a mean of 40 hours and a standard deviation of 5 hours. All the hospitals work 24 hours and the ambulance services are also offered round the clock.

Handling Requests

The existing ambulance deployment policy can be described as a “star network” with a centralized control from a logistics perspective. All idle ambulances are stationed at the mutt premises. Similarly, after handling a request the empty ambulance always returns back to the mutt before being assigned the next task. A typical routine for handling a request follows the steps outlined below:

1. A request for ambulance service is made from an accident spot, which could be from one of the zones in the area.
2. If an ambulance is available at the time the request is made, it is immediately dispatched. If there are no ambulances, the location of the accident is noted down and as soon as an ambulance is free it is directed to the accident spot.

¹ Turnaround time is the elapsed time from the occurrence of the accident to the time the patient was reached to a hospital that had the capacity to attend to the patient.

3. There are four Government hospitals in that area (denoted as H1, H2, H3, and H4). Each hospital has a fixed number of beds for such emergency cases (currently 10 each). As soon as the ambulance arrives at the accident spot, the victim is “wheeled into” the ambulance if he/she is alive. If the victim is already dead, the ambulance returns to the mutt or to the point of next demand.
4. If the victim is alive, some first aid is given and the hospitals are contacted in the order of their proximity to the accident spot for availability of free beds and the victims transported accordingly.
5. When none of the four hospitals have a free bed for accommodating the victim, it has been the practice to take the patient to the nearest hospital and leave him/her there.
6. Sometimes a fraction of the victims (20%) decide to get admitted to a more expensive (private) hospital and under such circumstances, the victim is taken to the respective hospital.
7. After the patient is “wheeled out” of the ambulance into any one of the hospitals as outlined above the ambulance returns back to the mutt premises and await its turn again. However if there is already a message of a waiting accident victim the ambulance will directly go there instead of coming to the mutt.
8. In the unfortunate event of the patient being declared “brought dead” by the destination hospital, the ambulance returns back to the point of origin of demand to “wheel out” the dead patient before returning back to the mutt premises or to the point of next demand as the case may be. .

Two measures of interest will be the turnaround time for the ambulance and the turnaround time for the patients. Given the operating policy, it could be defined as follows:

Turnaround time for Patients (TATP):

- a) Elapsed time between placing the demand for ambulance and availability of the first free ambulance +
- b) Travel time of empty ambulance from its current location to the origin of demand +
- c) Patient “wheeling in” time +
- d) Time for transit from origin of demand to the designated hospital +
- e) Patient “wheeling out” time.

Turnaround time for Ambulance (TATB):

The turnaround time for the ambulance depended on the status of the patient. Three possible scenarios exist.

Scenario 1: Patient is already dead by the time the ambulance arrived

TATB is given by:

- a) Travel time of an empty ambulance from mutt premises (or any other location) to the origin of demand +
- b) Travel time of empty ambulance back to mutt premises or to the next location from the point of origin of demand

Scenario 2: Patient is dead when the ambulance arrived at the designated hospital

TATB is given by:

- a) Travel time of an empty ambulance from mutt premises (or any other location) to the origin of demand +
- b) Patient “wheeling in” time +
- c) Time for transit from origin of demand to the designated hospital +
- d) Travel time of empty ambulance back to mutt premises (or to the next location) from the hospital

Scenario 3: Patient is alive when the ambulance arrived at the designated hospital

TATB is given by:

- a) Travel time of an empty ambulance from mutt premises (or any other location) to the origin of demand +
- b) Patient “wheeling in” time +
- c) Time for transit from origin of demand to the designated hospital +
- d) Patient “wheeling out” time +
- e) Travel time of empty ambulance back to mutt premises (or to the next location) from the hospital

Recent issues

It is nearly a year since the ambulances were procured by the mutt and put into service. Therefore the *Swamiji* was keen to know if the idea met with the broad objectives of improving the healthcare of the rural folk. From the mutt personnel perspective, the ambulances have on an average serviced five requests everyday. Perhaps the utilisation of the ambulances may be in the range of 50% as the staff felt that nearly half the time the ambulances were stationed at the mutt only. According to them there was definitely a scope for improving the utilisation of these ambulances before we think of adding more ambulances. However, by providing transportation facilities for the patients to reach the hospitals in a timely fashion, the mutt has made a significant difference to the status of healthcare in the region. Judging by these utterances of the mutt personnel, the overall impression is that the purpose is very well served.

Swamiji had invited some prominent personalities from several of the villages that are likely to benefit from the ambulance services to understand their perspectives. In all people from 23 of the 74 villages attended the meeting. Interestingly, the

perspective of the villagers differed from those of the mutt personnel on certain issues. When the group was contacted, they had the following to say:

The initiatives taken by the Swamiji is very good as it has been in the past. Thanks to his good offices, we are able to access the hospitals much more easily than before. However, in the last one year we also notice that there have been occasions when the patient reached the hospital and was declared "brought dead". Some of us felt that there was indeed some delay in the arrival of the ambulance to the point of origin that could have caused this. It will be indeed more helpful if one more ambulance is put into service.

The meeting with the villagers triggered some action at *Swamiji's* level. If the services were still not reaching the masses and delivering what they needed, where was the problem? He felt that the mutt had no idea about the extent to which the ambulances are used and the number of deaths occurring due to the late arrival of the ambulance. Fundamentally he wanted to know how one should judge the performance of the ambulance services that the mutt is offering. *Swamiji* was also keen to understand more about the level of service offered to the rural masses. He felt that one year was sufficient enough time to make an assessment and mid-course correction if required. The young disciple, who graduated recently from one of the IITs volunteered to study the problem and enlighten him more. The *Swamiji* was keen to listen to the disciple.

Study of the existing ambulance operation

The young disciple did a detailed study of the problem by building a simulation model. After starting from an "empty and idle" condition the simulation was run after deleting an initial warm up period. The average of ten such replications of each of 400 hours duration was used to collect data. The advantage of the simulation model was that in addition to studying the existing scenario it would also be possible to study several other alternatives for the problem. The following alternatives were studied:

- Increasing the number of ambulances (three scenarios of 3, 4 and 5 ambulances were studied)
- Alternative strategies for the existing scenario (of 2 ambulances)
 - Parking the empty ambulance in places other than the mutt
 - Changing the order of priority of servicing multiple requests
 - Effect of improving the road infrastructure (this was studied by increasing the speed at which ambulances can travel)

Specifically the disciple wanted to understand the likely impact of alternatives on several key performance metrics:

- (a) The number of patients dead before the ambulance arrived
- (b) The number of patients dead by the time the ambulance reached the hospital
- (c) The number of patients getting admitted in the private hospitals
- (d) Waiting time for the ambulance and hospital bed

- (e) Transport time
- (f) Utilization of ambulance and hospital bed

The results of the simulation are available in exhibits 6 and 7, which he presented to the *Swamiji*.

The *Swamiji* has now to decide his future course of action. While the whole exercise began with a keen desire to help the villagers on an important issue of healthcare how far the objectives have been met? Where is the window of opportunity to make this better? Should he invest in more ambulances? How will it help? Where is the wherewithal for this? Can he extend his sphere of influence on the public policy domain and get some help from the government representatives?

Exhibit 1
Status of Healthcare in India – Some indicators

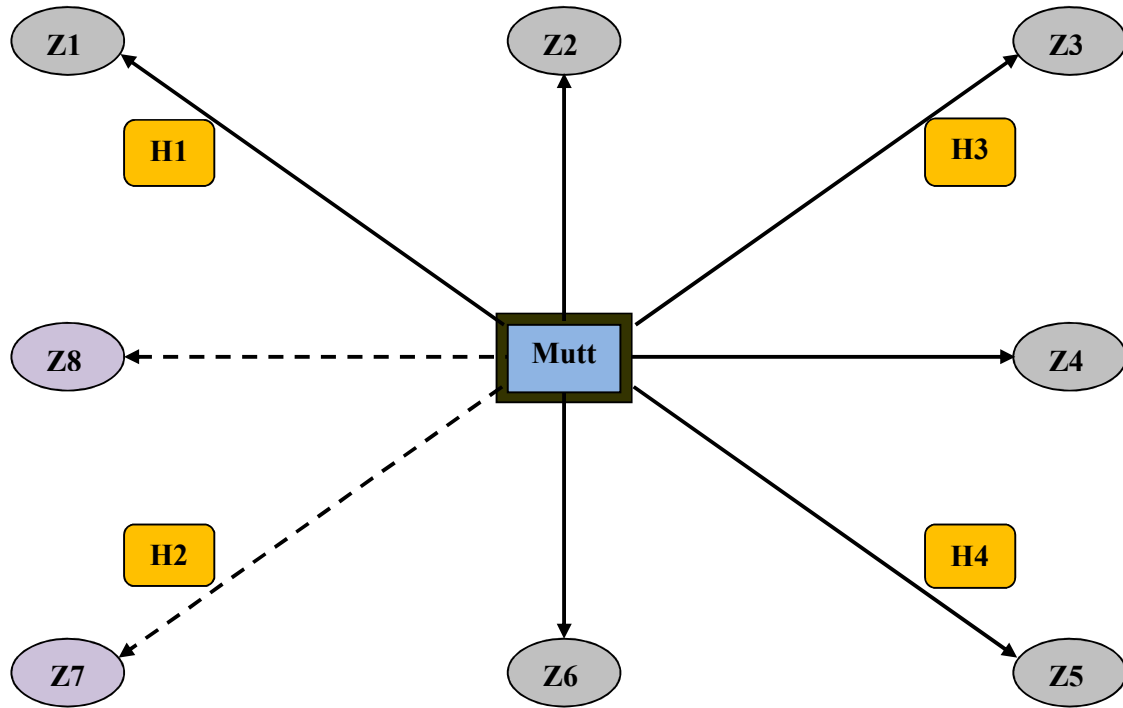
Sl. No.	Country	No. of physicians (per 10,000)	No. of health workers (per 10,000)	Hospital Beds (per 10,000)
1	Germany	33.70	100.50	89.00
2	USA	27.90	97.20	34.00
3	Australia	24.70	91.20	40.00
4	UK	21.30	54.00	42.00
5	Singapore	14.00	44.50	29.00
6	China	16.40	9.60	25.00
7	Malaysia	7.00	18.10	19.00
8	India	5.90	13.80	9.00

* Source: World Health Statistics, 2005, WHO

Status of Healthcare Manpower in Rural India				
Sl. No.	Manpower details	Required	Available	Shortfall
1	Doctors at Primary Health Centers	25,724	22,842	2,882
2	Specialists	12,172	4,124	8,048
3	Pediatricians	3,043	440	2,603
4	Physicians	3,043	704	2,339
5	Surgeons	3,043	781	2,262
6	Health Assistant (Male)	22,842	19,927	2,915
7	Health Assistant (Female)	22,842	19,855	2,987
8	Health Worker (Male)	137,311	71,053	66,258
9	Pharmacists	25,885	21,118	4,767
10	Lab Technicians	25,885	13,262	12,623
11	Mid-wives/Nurses	44,143	27,336	16,807

* Source: Health Information of India, 2004, Central Bureau of Health Intelligence

Exhibit 2
Geographical location of the Zones, mutt and hospitals



Legends

- H1 to H4 : Location of the four hospitals
- Z1 to Z8 : The Eight Zones in the area
- ▶ : Denotes well laid out road
- - - - -▶ : Denotes poor roads

Exhibit 4
Zone-wise distribution of accident frequency

Zone number	Frequency of accident
1	7 %
2	8 %
3	20 %
4	12 %
5	20 %
6	8 %
7	13 %
8	12 %

Exhibit 5
Relationship between elapsed time and death occurrence

Elapsed time after the accident	Probability of death
20 Minutes	5 %
40 Minutes	10 %
60 Minutes	15 %
80 Minutes	20 %
100 Minutes	23 %
120 Minutes	27 %

Exhibit 6
Results of the simulation analysis for varying number of ambulances

Key Performance Metrics	Number of ambulances			
	2	3	4	5
No. of deaths before ambulance arrival	27.05	14.38	11.68	10.47
No. of deaths after reaching the hospital	58.57	50.34	49.01	45.21
Total number of deaths observed	85.62	64.72	60.69	55.68
No. admitted to the private hospitals	0.24	0.65	1.05	1.31

Utilization Statistics (%)	Number of ambulances			
	2	3	4	5
Ambulance	62.83	46.79	36.25	28.03
Hospital 1 Beds	54.12	67.37	70.17	70.16
Hospital 2 Beds	74.89	81.23	83.08	81.05
Hospital 3 Beds	76.55	80.16	82.97	80.44
Hospital 4 Beds	61.00	71.37	72.72	70.09

Waiting & Moving Time Statistics (mins)	Number of ambulances			
	2	3	4	5
<u>Live patients</u>				
Waiting time for resources (Beds & Ambulance)	37.20	40.49	43.30	45.08
Travel time to the hospital	25.72	25.67	25.48	25.53
<u>Patients dead before arrival of ambulance</u>				
Waiting time for ambulance	70.14	38.77	32.71	31.22
<u>For those brought dead to the hospital</u>				
Waiting time for ambulance	43.87	34.05	32.02	31.40
Elapsed time to reach the hospital	73.23	62.25	62.15	61.86

Exhibit 7
Results of the simulation analysis for alternative strategies with
existing scenario

Key Performance Metrics	Alternative Strategies			
	Base Case	Longest Waiting	No home return	Faster Travel
No. of deaths before ambulance arrival	27.05	31.75	17.68	7.39
No. of deaths after reaching the hospital	58.57	58.81	45.47	24.24
Total number of deaths observed	85.62	90.56	63.15	31.63
No. admitted to the private hospitals	0.24	0.30	1.63	5.74

Utilization Statistics (%)	Alternative Strategies			
	Base Case	Longest Waiting	No home return	Faster Travel
Ambulance	62.83	66.84	42.99	43.65
Hospital 1 Beds	54.12	52.63	65.53	82.60
Hospital 2 Beds	74.89	74.84	82.40	89.94
Hospital 3 Beds	76.55	73.13	84.25	89.45
Hospital 4 Beds	61.00	60.68	73.11	82.92

Waiting & Moving Time Statistics (mins)	Alternative Strategies			
	Base Case	Longest Waiting	No home return	Faster Travel
Live patients				
Waiting time for resources (Beds & Ambulance)	37.20	36.40	33.88	85.70
Travel time to the hospital	25.72	25.79	25.85	16.98
Patients dead before arrival of ambulance				
Waiting time for ambulance	70.14	70.08	66.10	32.68
For those brought dead to the hospital				
Waiting time for ambulance	43.87	46.49	36.35	25.49
Elapsed time to reach the hospital	73.23	71.64	72.51	41.49