From the Editor’s Desk

EMERGENCY MEDICAL SERVICE AND PRIORITY QUEUING SYSTEMS

One of very challenging tasks in hospitals is attending an emergency case involving critical care, which needs quick assessment, prompt action and often administering advanced medical procedures for saving a patient’s life. In fact, critical care is fast emerging as a specialty in its own right, which involves immediate protection of the patient's breathing and blood circulation, two functions that mainly contribute towards one's living. An emergent critical care situation that requires immediate attention is cardiac arrest which occurs due to blockage in arteries. Cardiac arrest is however reversible if it is addressed within a few minutes of its occurrence with a process known as defibrillation that involves application of electric shocks to heart for restoring normal heartbeats. This is done by implanting devices similar to pacemakers called defibrillators, which are placed under the skin for treating abnormal rhythms. A victim’s chance of survival may reduce by 7 to 10 per cent with every passing minute if the patient is not provided with CPR and defibrillation facilities. Often life threatening emergency medical service is very critically important service in a hospital.

Two standards of effectiveness of emergency medical service are response time and service time. Response time refers to the time between the notification of an emergency and the arrival of an ambulance at the scene. Response time is time elapsed from the dispatch of an ambulance and the arrival of an emergency vehicle at the emergency scene. Service time is defined as the total time between notification of an accident and delivery of the patient to the hospital. Service time is the time from the dispatch of the ambulance to the arrival of the patient at a hospital. While the former standard emphasizes a rapid response of vehicle and trained crew to an emergency situation, the latter indicator specifies rapid transport of patient to a more fully equipped hospital emergency room.

Whereas public hospitals send an ambulance free of charge, private ambulance service providers commonly charge a basic amount per call, a kilometerage rate, and a charge for incidentals (e.g., linens, bandages, oxygen, splints, resuscitators, etc.). Charges typically include fixed charges in rupees per call, fixed charges for incidentals, and transportation charges between demand point and hospital.
General private ambulance service providers make no distinction between patient transfers and emergency calls. Private ambulance service providers generally find the service financially unattractive except in heavily populated areas or where ambulance services are a secondary activity. Government thus need to compensate by offering subsidy to private service providers. [Daberkow, S.G. and King, G.A., Rural Emergency Medical Facilities, *American Journal of Agricultural Economics*, 465-477 (1977)].

Queues are a common sight in number of service situations such as a ticket counter, a bank counter, a milk booth or a service provider in hospital. Queues may involve from short to excessive waits often leading to annoyance, and in hospital emergencies waits may impact on one's life and death. In business waits invariably cause low performance levels and persistent delays due to inadequate service providers may adversely affect competitive advantage. Facility planners thus need to weigh consequences of excessive wait and cost of providing a given level of service, a field of study, which over the past five decades has sufficiently matured into a body of literature known as queuing theory. Benefits of reducing congestion needs to be balanced against the costs of achieving it.

A queue always involves some distinctive features, namely, arrival pattern of customers, service pattern of servers, queue discipline, system capacity, number of service channels, traffic intensity or utilization and various service stages. A number of service patterns are possible, single server, multiple servers, in series or parallel and combination of these. Arrival pattern of customers is expressed in terms of arrival rate or the inter-arrival time. In some cases customers arrive in batches or blocks (e.g., the arrival of stock at a warehouse). Service pattern can be specified by the service rate or the service time. It is common for the service rate to increase during peak periods or over time periods when there is pressure to return home early.

Evolution of queuing theory started from the seminal work of Danish telecom professional A.K. Erlang. While mathematics of queuing theory is fairly complex, but applications have become much simpler following availability of IT softwares. In design of hospital system, it is important to ensure availability of service providers in all its business units wherever queues build up, be it, out-patient services, in-patient services, emergency services, or laboratory services.

Space has to be provided not only for stationing service providers, but also for accommodating from small to long queues that are common sight in most large hospitals. System capacity is the maximum number of customers...
including those being served as well as those waiting in the queue permitted in the system. When a customer arrives at a system which is full, he is not allowed to wait but has to leave without receiving service. A system with no limit on the number of customers has infinite capacity, otherwise it has finite capacity. Efficiency of a system can be improved by training servers, using better machinery or by increasing the number of servers.

A number of terms are linked with queuing systems such as balking, reneging and jockeying. When the customer does not enter the system when the queue is very long is called balking. Reneging refers to a case when the customer in the queue leaves without service as his waiting time has exceeded a certain limit. Jockeying refers to a phenomenon when in multiple queuing situations, a customer may move from one queue to a queue with a shorter length or faster service rate.

Queuing models which are part of broad domain of operations research are developed on the basis that individuals shall be served on first-come-first-served basis. However, models will change when this rule is changed to other options such as last-come-first-served, service in random order, service by priority, etc. A number of real-life situations involve priority considerations. Application of queuing theory of which 'priority queuing' is a special topic is very relevant in resource planning for hospital services particularly emergency services. Priority queues are generally more difficult to model than first-come-first-served based (Gross, D. and Harris, C.M., Fundamentals of Queuing Theory, John Wiley & Sons, New York, 1974, p.178).

In priority queuing systems, customers with the higher priorities are served first, independent of their time of arrival into the system. Application of priority queuing concept is based on the premise that when high priority calls are served faster at the expense of little extra waiting for low priority calls (but not inordinate delay), both high priority and low priority streams can be served fairly rapidly though at differential rates, achieving high performance standards but keeping the overall service costs low. In other words, low priority calls have to wait marginally extra with corresponding faster service to high priority calls. This enables estimates of critical resources based on priority reservation policy whereby low priority cases have to be served only when resources (servers) more than a specified cut-off value are available.

Estimation of ambulance fleet size, determination of number of beds or other key resources in critical care units are common examples of priority models in emergency service. While estimating ambulance requirement using
priority queuing approach, when an ambulance service provider receives a call for dispatching ambulance, based on preliminary discussion with the caller on phone, he will decide whether the ambulance is to be sent immediately if according to him it is an emergency case, or caller can be made to wait little more till number of ambulances at his end reach the pre-determined cut-off level.

In the same manner as in ambulance service, priority queuing concepts can be applied in resource planning for elective-surgeries cases by accommodating few such cases in ICUs (intensive care units). While beds have to be reserved for treating emergency cases in the first priority for which ICUs primarily exist, but when emergency load is limited and some beds up to a threshold limit are anyway reserved, it is sensible to admit few cases of elective surgeries in ICUs, with a view to avoid risk of their turning away to other hospitals. A flexible policy can be made to admit selective surgery cases in ICU units when normal ICU load is less up to a limit based on past hospital data. Flexible bed prioritization policies of this nature can be designed using simulation and queuing analysis on the hospital data.

Policy of accommodating elective surgery patients in ICUs is practiced in many hospitals as often they need same monitoring facilities as needed by emergency patients and if they are denied admission for long due to bed shortages, a corporate hospital runs the risk of losing some elective-surgery patients, who may turn away to other hospital following non-availability of beds. This is more so when elective-surgeries also need high degree of intensive care which ICUs provide, but who can be admitted in ICUs under the policy of more than the required number of beds available therein, otherwise they will be made to wait till the condition of cut-off limit is achieved.

EMRI (Emergency Medicine and Research Institute) is a comprehensive emergency response ambulance service which is available in all areas of Andhra Pradesh, Gujarat, Uttarkhand, Goa and Meghalaya and is being introduced in several other states including Rajasthan, Karnataka, Assam, Madhya Pradesh, and Tamil Nadu. There is provision under the National Rural Health Mission (NHRM) for financing such schemes, for which the states are availing this option. EMRI ambulance is well-equipped with several emergency facilities. It has disposable syringes and anti-snake venom, and equipment to deal with emergencies like drowning and poisoning.

EMRI in Gujarat handles about 2000 emergencies a day. The emergency medical service is absolutely free and the ambulances take patients only to
hospitals, which have signed an MOU with EMRI for receiving patients and handling emergencies. The cost of this ambulance service varies from Rs. 10 lakh to Rs. 16 lakh depending on whether the ambulance is equipped with Basic Life Support (BLS) or Advanced Life Support (ALS) equipment.

When there is a medical emergency in a village, the villagers call 108, which is a toll free number. The call center directs the nearest ambulance to reach the village. It has an Automatic Vehicle Location and Tracking System (AVLTS). The call centre physician decides whether to dispatch a BLS or an ALS to site. On reaching the site, the ambulance crew gets down to their task. Whenever necessary, the EMT calls the call centre, gets on line with a doctor and seeks his advice. He also arranges a conference call of a friend or relative of the patient with the doctor, so that everybody is in loop with regard to the nature of the emergency and the course of treatment suggested by the doctor.

The running cost for the fleet in Gujarat is around Rs. 60 crore a year based on running cost expenditure norm of Rs. 1.25 lakh per ambulance per month. BLS ambulances have oxygen cylinders, suction pumps, cervical collars for immobilization of the patient, drips and measuring instruments to analyze oxygen level in the blood, blood sugar, etc. In Gujarat in 2008 EMRI handled 4.25 lakh cases, out of which 1.21 lakh cases related to pregnant women, who were required to be rushed to the hospital.

ALS ambulances on the other hand have ventilators and defibrillators fitted to it. They can take an ECG and transmit the same to the call centre where physicians work round the clock and advise the Emergency Medical Technician (EMT) in the hospital on pre-hospitalization medication to be given to the patient. Medical opinion of the doctor in call centre and the patient's ECG are dispatched to the hospital in advance so that treatment and procedures can begin soon after on arrival.

Ambulances are serviced regularly and the tyres changed after the mandatory mileage. EMRI has helped bring down Infant Mortality Rate (IMR) and Maternal Mortality Rate (MMR) in Gujarat where this facility is linked with the Janani Suraksha Yojana (JSY), which incentivizes expectant mothers to deliver their babies in civil hospitals or primary health centers.

Assessment of helpful attitude is an important criterion for selection of EMRI staff. EMRI has currently over 12000 employees all over India but more concentrated in states like Gujarat, Uttarkhand and A.P., where the
scheme is firmly in saddle. In Andhra Pradesh, EMRI is linked with Arrogyasri, the health insurance scheme. Ambulance crew is provided with digital camera for obtaining photographic evidence in medico-legal cases. This information is often required to be passed on to police. All calls to the crew and from them are recorded and made available in medico-legal cases to investigators and courts (Prakash, S., Miracle called 108 Emergency Medical Service, Sunday Pioneer, April 5, 2009).

EMRI plans to increase its fleet to 4000 ambulances in 11 states eventually, which is planned to go up to 10000 by 2010. The organization is however facing some financial problems which are likely to be overcome following a proposed value chain partnership with Piramal Healthcare, which will also provide impetus to R&D (The Times of India, Hyderabad, May 21, 2009)

Successive governments at the center have been promising higher public expenditure on health to the tune of between two and three per cent of the GDP, but actual spending (a statistic inflated by including spending on social determinants such as drinking water and nutrition) was a mere 1.39 per cent during 2007-08. Much remains to be done in improving healthcare infrastructure particularly in rural India though National Rural Health Mission has planned extending services to far-flung populations. These measures, however, do not address the unaffordable cost of managing chronic ailments arising out of longevity or social circumstances, and of emergency medical care.

An expanded, free, healthcare system and improved publicly funded health infrastructure could have benefited millions of people who did not avail healthcare in view of high medical costs and more so within the backdrop of global meltdown. Much of the country's population is constrained to spend on healthcare out-of-pocket. The National Commission on Macroeconomics and Health, using new methodologies, estimated in 2005 that households were obliged to use their own resources for 68.8 per cent of the aggregate national spending on health, while the share of the central and state governments together was 21.6 per cent (the rest was accounted for by public sector, private, and charitable sources). Government investment in health has positive externalities in the form of reduced social costs of morbidity and removal of inequality. Price subsidies or availability of effective direct public health services will encourage more people to avail it.

Need for massive public investment in healthcare is overriding as this sector cannot be left to market forces that largely serve upper income group families only. Even in the United States, this need for effective public
healthcare service has received government priority for government-funded health insurance scheme for promoting universal healthcare. In consonance with such policies of Obama Administration India also needs to come-out with a comprehensive plan to reduce out-of-pocket expenditure for all citizens, build first-class primary health care, and widen access to tertiary care through public facilities (The Hindu, Financing Health, Editorial, April 6, 2009, p.8). A special funding mechanism to create access to and underwrite treatment costs for chronic ailments, such as cardiovascular conditions, diabetes, kidney disease, cancer, and emergencies of all kinds should be accorded high priority as compared to other areas. This investment by government is very necessary for preventing countrymen from becoming poor on account of huge expenditure on such ailments when they hit individuals.

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Turning Events

MAULANA AZAD: A GREAT INDIAN LEADER AND CHAMPION OF NATIONAL UNITY

Abul Kalam Azad was born on November 11, 1888 in the holy city of Mecca to an Indian 'Pir' scholar Maulana Kairuddin and Arabian lady, whose ancestors hailed from Herat, a holy city in Afghanistan. In 1890, his family moved to Calcutta where it settled. He adopted his pen name 'Azad' to project his freedom from traditional orthodoxy ways of those times. In 1912, Abul Kalam started his weekly Al-Hilal to arouse conscience of Islamic brethren for adopting lofty Islamic values and participating in India's freedom movement. The pluralist society saw in him a scholarly voice of India's composite culture representing India's different faiths. Bharat Kokila (Nightingale of India) Sarojini Naidu used to say: "Do not talk of Azad's Age. He was fifty the day he was born."

Turning event of his life began the day he severely criticized Partition of Bengal. His political career began when he opposed partition of Bengal in the beginning of the 20th century when he met some well-known Indians of those times such as Aurobindo Ghose, Lala Har Dayal, and Shyam Sunder Chakravarthy, who supported him for his opposition to Bengal partition. Maulana Azad's meeting with Mahatma Gandhi in January 1920 at the residence of Hakim Ajmal Khan in the august presence of Lokmanya Tilak and Ali Brothers, became a major turning event in his public life. Initially Khilafat movement, and later on non-cooperation movement launched by Gandhi, provided a broader platform to Azad's political career. Hindu-Muslim unity visualized by Mahatma Gandhi channelized Khilafat Movement into nationalist movement.

Between 1915 and 1920 he was greatly drawn towards Gandhian ideologies. In 1920, Abul Kalam participated, along with large number of followers in Civil Disobedience Movement launched by Mahatma Gandhi. He first became President of Indian National Congress when he was barely 35 years and he was again the...
Congress President in the year of India's independence. In 1945, he attended the Simla Conference and interfaced with the Cripps Mission involving the visit of Sir Stafford Cripps to India in 1946 relating to the transfer of power to the Indian sub-continent.

Maulana Azad's standing as a distinguished scholar of oriental learning was demonstrated in shaping country's educational system in the post-independence era. He set up the University Education Commission in 1948. In free India, after first general elections (1952), he became country's first Education Minister, and continued till his demise in 1958. As Education Minister, Maulana Azad reorganized the All India Council for Technical Education (AICTE) and the Secondary Education Commission in 1952.

Maulana Azad was also instrumental in establishing the Indian Council for Cultural Relations and when he became its first President, while welcoming a Pakistani delegate attending the ICCR meeting for the first time, Maulana Azad said, "We have separated on political grounds but we have been one people and our cultural life is such that it cannot be divided without the loss of both."

Maulana Azad was largely responsible in setting up three academies - Sangeet NatakAkademi, Sahitya Akademi, and Lalit Kala Akademi - to promote music, literature and art. He extended full support to Pt. Nehru in setting up the Council for Scientific and Industrial Research and a chain of laboratories under its control. He also played noted role in setting up India International Centre at Lodhi Road (New Delhi) and WUS Health Centre at Delhi University. On his initiative, the budgetary allocation for education was raised to fifteenfold between 1947 and 1958.

After independence he wrote the book, 'India Wins Freedom', which provided a very authoritative account of India's freedom movement. He was deeply upset with country's partition and the book provided ample evidence of his deep pain and anguish of this unfortunate development linked with India's freedom. He breathed his last on February 22, 1958. While condoling his death, Pt. Nehru said: "Passed a great man, a man of luminous intelligence and a mighty intellect with an amazing capacity to pierce through a problem to its core". At the time of his burial near Jama Masjid in Delhi, a very huge gathering of countrymen had collected to bid emotion-packed farewell to country's one of the greatest sons and freedom fighters, which included a tear from Pt. Nehru's eyes as well, which trickled down from his cheeks and rolled down into Maulana Azad's grave.

As a mark of respect to the country's one of the greatest leaders, a number of organizations and educational institutions in the country are named after him including Delhi's famous Maulana Azad College of Medical Sciences, and the Maulana Azad Education Foundation, which receives partial financial support from the Union Ministry of Social Justice and Empowerment.

--Editor

REFERENCES
