Original Article

RESCUE 1122: APPLICATION OF POISSON DISTRIBUTION

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ABSTRACT:

OBJECTIVE: The basic idea of the study toevaluate the probabilities of various emergencies calls that could be emerging in the enhancement of operational network and adequate polices to tackle the complex emergencies situations, so that the maximum human lives and disaster of properties could be declined.

DATA: The relevant data for the present study is taken from rescue 1122 official website of all thirty six districts.

PERIOD: 10/10/2004 to 3/2/2014.

METHODS: Descriptive analyses along with Poisson distribution are carried out. Poisson probability distribution is executed by using the R programming language.

RESULTS: On the basis of descriptive analysis about 85.9% calls are associated to medical (47.5%) and road accident (38.4%) emergencies. While the road accidents and medical emergencies calls are significantly high in Gujranwala and Dera ghazi Khan Division respectively. Under Poisson distribution the chance that the patient rescued is 85%. Further the maximum emergency calls arrivals with at least 90%, 95% and 99% certainty per day are computed.

CONCLUSION: The proportion of medical and road traffic accidents emergencies calls are significantly high. Prediction about emergencies calls will serve as a guide in improving rescu1122 management and operational network.

KEYWORD: Emergencies, Rescue 1122, Poisson distribution;

INTRODUCTION:

Deaths and disability are preventable for situation such as trauma, pregnancy, myocardial infraction, stroke and sepsis by improving the emergency services[1]. In a modern era, Pakistan has long been neglected with the modern equipped medical emergency services, particularly pre hospital emergency care. This vacuum is filled in 2006 after establishing the rescue 1122 emergency service, now it is functioning in all thirty six districts of Punjab successfully and replicated to other provinces. Recently it is started in Khyber Pakhtunkhwa. Paramedics are specially trained on modern lines with sufficient skills and knowledge to tackle the emergencies situation like pre-hospital emergence care, road accidents and disasters. In five year performance report presented in 2009 the service has rescued 396,995 victims and maintaining the response time less than 7 minutes[2]. Rescue 1122 is simply accessed by dialing 1122 and provided the quick emergency care, considerably two major emergencies

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namely road accidents and medical emergency, like serve infections, intentional and unintentional time sensitive injuries.

A ten year data taken from emergency service department rescue 1122 of four major cities of Punjab revealed that medical and Road traffic accidents (RTAs) emergencies were 247692, 82910; 112531, 31069;243481, 92367 and 52507, 33847 in Lahore, Faisalabad, Multan and Rawalpindi respectively and sometime RTAs increased and more than medical emergencies[3]. As (RTAs) are major general public health concerns particularly in developing country including Pakistan. The RTAs fatalities and disabilities in low- and middle income countries are more than 85% and 90% respectively[4]. In Pakistan, the pedestrians and the rider of motorized (2 or 3 wheelers) at on greater risk and the leading cause of RTAs fatalities 41% and 39% respectively[5]. The main reason of traffic road accident is lack of awareness about traffic sense codes and orders, driver related factor, overloading over speed use of cell phone during driving and vehicle related factor[6]. RTA will become the fifth leading cause of death by 2030 resulting in an estimated 2.4 million fatalities annually. A study conducted and under the descriptive analysis found that Punjab contributes to a high rate of total number of accidents, while Khyber Pakhtunkhwa, Sindh and Baluchistan placed second, third and fourth respectively, while under the cubic modelRTAsis expected to rise in Pakistan[7].

This study has a definite object to explore role of rescue 1122 emergency service as well as an application of Poisson distribution that enables us to know the probabilities of various emergency calls per day that might be helpful in improving the performance of rescue 1122 management and operational network so that the maximum lives could be saved.

METHOD AND MARTIAL:

Source of data:

Punjab is a highly populated province of the Pakistan with nine divisions and thirty six districts. The relevant data for the present study is taken from rescue 1122 official website[8] from 10/10/2004 to 3/2/2014.Various emergencies calls for all districts namely road accident, medical, fire, building collapse, crime incidents, drowning, blast explosion, miscellaneous are taken under descriptive analysis and Poisson distribution. Poisson distribution is executed by using R programming language[9].

Methods:

The Poisson distribution is a discrete probability distribution for the counts of events that occur randomly in a given interval of time (or space). let X = the number of events in a given interval, Then, if the mean number of events per interval is λ. The probability of observing x events in a given interval is given by Where "x" is Poisson random variable and takes value from 0,

$$P(X = x) = \frac{e^{-\lambda}\lambda^{x}}{x!} \quad (1)$$

1,2,3,4...infinity and λ is a parameter for Poisson distribution.[10], [11] The average numbers of emergency calls received by rescue 1122 service centre per day.

RESULTS AND DISCUSSION:

Per day emergency calls at rescue 1122 service center are illustrated in Figure 1.About 85.9% calls are associated to medical and road accident. Out of 100 emergency calls 47 are medical treatment while 38 calls are road accident per day. While 8 call is miscellaneous. Figure 2 showing the detail of emergency calls division wise (9 divisions). It is obvious that Rescue 1122 is much engage in emergency calls that are belonging to medical treatment and road accident respectively. Gujranwala is the only division that has minimum calls for medical emergency and road accident is also significantly high in Gujranwala district as compared to other districts. Fire, building, collapse, crime incident, drowning, bomb blast emergency calls is significantly low throughout the entire divisions. The detail description of percentage distribution of medical and RTAs emergencies of thirty six districts are depicted in Table 1 with higher proportion of medical and RTAs emergencies.

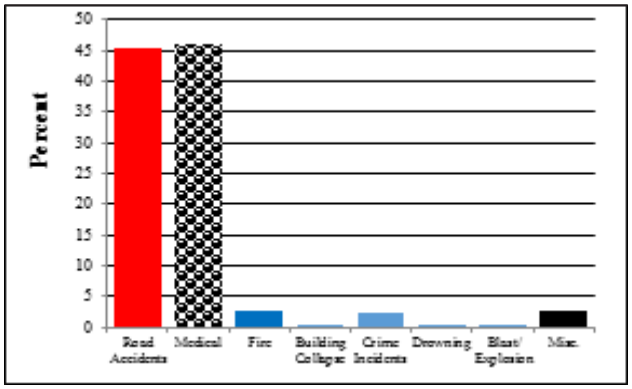


Figure 1: Emergency call in Punjab

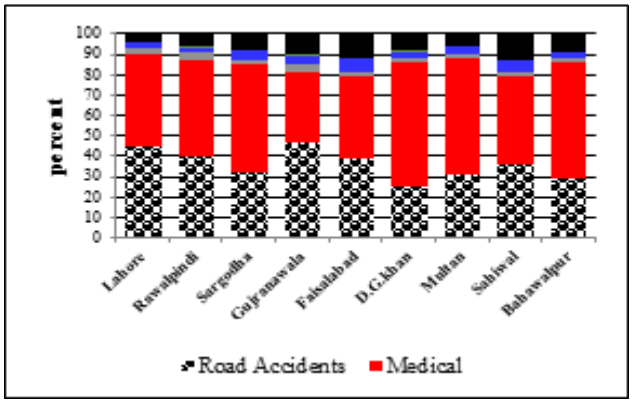


Figure 2: Emergency call in Devision

Poisson distribution:

A Poisson distribution is carried out to know the probabilities of various emergency calls per day. In overall Punjab there are 18% chances that the received call is non-emergency, if 50 calls are made per day. While the chance that the patient rescued is 85% in overall Punjab. A graphical illustration of Poisson probability density functions for different emergency calls in Punjab can be viewed from Fig (3) through Fig (6), while Poisson cumulative distribution functions, graphical presentation can be viewed from Fig (7) through Fig (10) in Punjab. The maximum arrival with at least 90%, 95% and 99% are given in table 1.At least a 90% chance that the number of emergency calls in any per day does not exceed 22.Equivalently Less than a 10% chance that there will be more than 22 emergency calls in any per day. Similarly at least a 99% chance that the number of emergency calls in any per day does not exceed 27.Equivalently Less than a 1% chance that there will be more than 27 emergency calls in any per day. At least a 90% chance that the number of emergency calls for road accident in any per day does not exceed 10.At least a 90% chance that the emergency calls for medical treatment in any per day does not exceed 12.Equivalently Less than a 10% chance that there will be more than 12 emergency calls in any per day. At least a 90% chance that the patient is rescued in any per day does not exceed 25.Equivalently Less than 10% chances that there will be more than 25 patients are rescued in any per day.

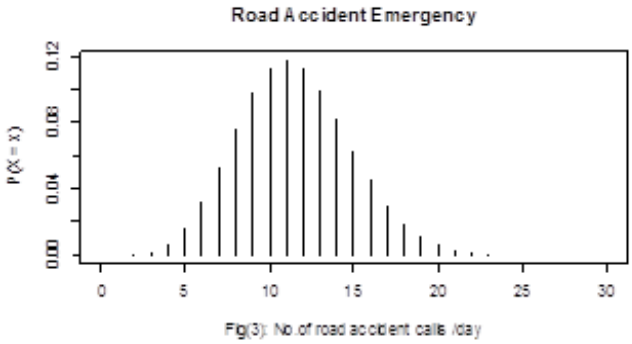
Table 1: Summary of maximum Emergency calls arrivals with at least 90%, 95% and 99% certainty per day.

	Per District		
Quantile	90%	95%	99%
Emergency Calls (overall)	22	24	27
Road Accidents	10	11	13
Medical	12	13	15
Fire	1	2	2
Building Collapse	0	0	1
Crime Incidents	2	2	3
Drowning	0	0	1
Blast/ Explosion	0	0	0
Misc.	3	3	5
Fake Calls	0	0	1
Patient Rescued	25	27	30

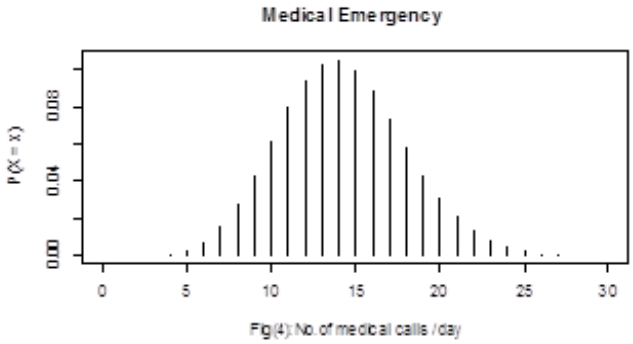
Table 1: Descriptive analysis of road accidents and medical emergencies in 36 district of Punjab

		Percent		
	Division	Road Accidents	Medical	Combine
	Lahore	44.54	45.24	89.77
	Sheikhupura	2.57	1.82	4.39
	Nankana Sahib	0.96	1	1.96
	Kasur	1.95	1.95	3.89
Total				100
	Rawalpindi	33.64	26.66	60.3
	Attock	4.65	14.45	19.09
	Jehlum	6.9	5.15	12.04
	Chakwal	4.83	3.75	8.58
Total				100
	Sargodha	29.19	29.77	58.95
	Mianwali	7.35	6.86	14.21
	Khushab	7.45	5.78	13.23
	Bhakkar	6.02	7.6	13.62
Total				100
	Gujranawala	24.01	27	51.01
	Gujrat	4.82	3.11	7.92
	Hafizabad	2.81	3.25	6.06
	MBDin	2.47	1.84	4.31
	Narowal	2.21	4.54	6.75
	Sialkot	13.7	10.29	23.98
Total				100
	Faisalabad	39.59	34.49	74.08
	Chiniot	1.13	0.52	1.65
	Jhang	5.89	11.03	16.92
	Toba Tek Singh	3.4	3.96	7.35
Total				100
	D.G.khan	24.59	28.65	53.24
	Layyah	7.29	3.66	10.95
	Muzafarghar	10.98	9.57	20.54
	Rajanpur	7.16	8.13	15.29
Total				100
	Multan	32.59	38.22	70.81
	Lodhran	5.42	4.82	10.24
	Khanewal	7.57	4.02	11.59
	Vehari	4.43	2.95	7.37
Total				100
	Sahiwal	29.09	29.24	58.33
	Pakpattan	9.74	10.26	20
	Okara	11.18	10.5	21.68
Total				100
	Bahawalpur	23.68	26.09	49.76
	Bahawalnagar	8.1	6.63	14.73
	Rahim Yar Khan	18.23	17.29	35.51
Total				100

Poisson probability density functions under various emergency calls in Punjab



Fig(3): No.of road accident calls /day



Fig(4):No.of medical calls /day

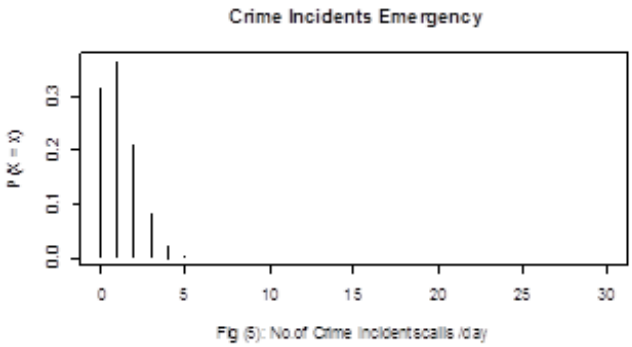


Fig (5): No.of Crime Incidentscalls /day

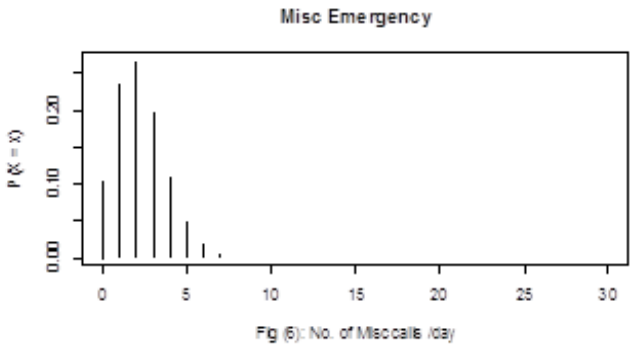
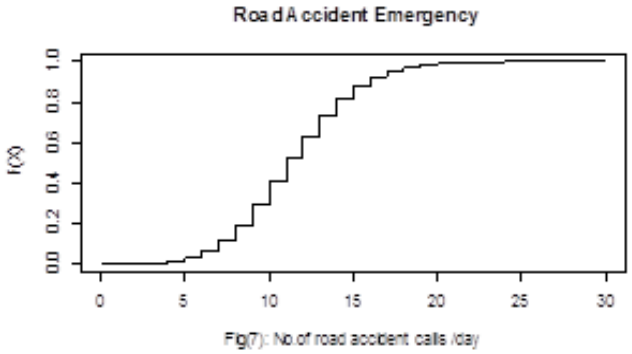
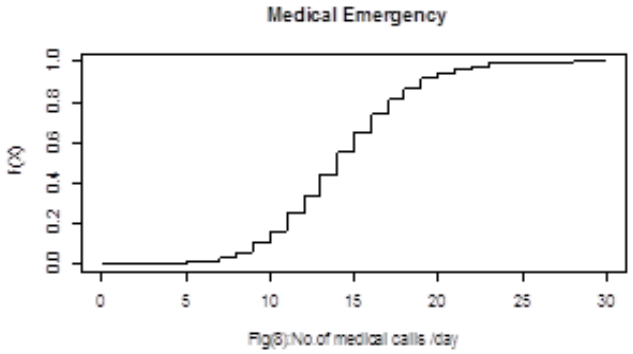


Fig (6): No. of Misccalls /day

Poisson cumulative distribution functions under various emergency calls in Punjab



Fig(7): No.of road accident calls /day



Fig(8):No.of medical calls /day

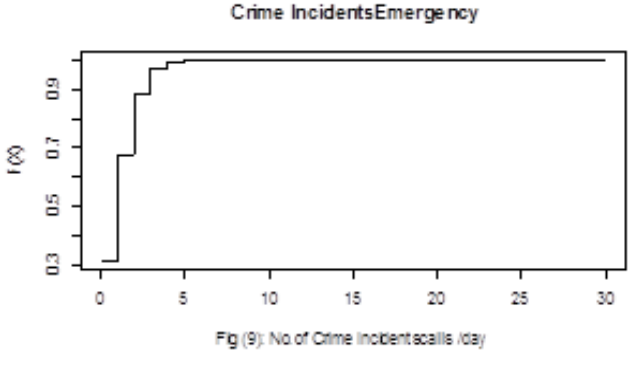


Fig (9): No.of Crime Incidentscalls /day

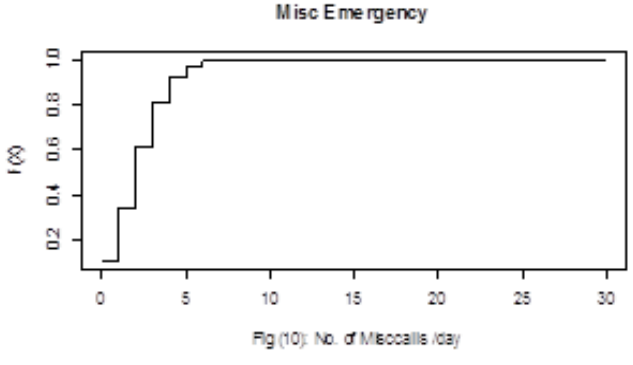


Fig (10): No. of Misccalls /day

CONCLUSION:

The generally findings revealed that the proportion of medical and RTAs emergencies are higher. Under passion distribution the probability that the patient rescued is 85% and at least a 90% chance that the number of emergency calls in any per day does not exceed 22. The availability of these statistical findings will serve as a guide in improving rescu1122 management and operational network, so that the maximum human lives and disaster of properties could be declined, a significant concern for a less develop country like Pakistan.

REFERENCES:

1. Razzak JA, Kellermann AL: Emergency medical care in developing countries: is it worthwhile? Bulletin of the World Health Organization 2002, 80:900-5.
2. Punjab emergency service: Rescue 1122 five years performance report: 2009.
3. Mansoor SA, Imam HSH, Shahzad MA. Emergency services1122; a ten years data from four largest cities in Punjab 2004-2014. Professional Med J 2015;22(2):163-166.
4. Murray CJ, Lopez AD: The global burden of disease and injury series, volume 1: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020. Cambridge MA 1996.
5. Organization WH: Global status report on road safety-Supporting a decade of action, 2013. Geneva, Switzerland 2013.
6. Khan AM, Tehreem A: Causes of road accidents in Pakistan. Journal of Asian Development Studies 2012, 1.
7. Imran M, Nasir JA. Road traffic accidents; prediction in pakistan. Professional Med J 2015;22(6):705-709.
8. Available at: wwwrescugovpk.
9. Horgan, J. M. (2009) Probability with R: an introduction with computer science applications, Hoboken, N.J., Wiley.
10. Gerlough DL, Barnes FC, Schuhl A: Poisson and other distributions in traffic.1900.
11. Gerlough DL, Schuhl A: Use of Poisson distribution in highway traffic: Eno Foundation for Highway Traffic Control, 1955.

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Submission to Allah's Will is the best companion; wisdom is the noblest heritage; theoretical and practical knowledge are the best signs of distinction; deep thinking will present the clearest picture of every problem.

The mind of a wise man is the safest custody of secrets; cheerfulness is the key to friendship; patience and forbearance will conceal many defects.

Hazrat Ali (Karmulha Wajhay)