RISK-ADJUSTED ANALYSIS OF PATIENTS UNDERGOING EMERGENCY LAPAROTOMY USING POSSUM AND P-POSSUM PREDICTION MODELS

Dissertation Submitted for

MS Degree (Branch I) General Surgery

April 2012

The Tamilnadu Dr.M.G.R. Medical University

Chennai – 600 032.

CERTIFICATE

This is to certify that this dissertation titled **"RISK-ADJUSTED ANALYSIS OF PATIENTS UNDERGOING EMERGENCY LAPAROTOMY USING POSSUM AND P-POSSUM PREDICTION MODELS"** submitted by **DR.NAWAZ USMAN** to the faculty of General Surgery, The TamilNadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the requirement for the award of MS degree Branch I General Surgery, is a bonafide research work carried out by him under our direct supervision and guidance from 2009 to 2011.

Prof. Dr. M.GOBINATH, M.S.,
Professor & Head of the Department,
Department of General Surgery,
Madurai Medical College,
Madurai.

Prof. Dr.A.SANKARAMAHALINGAM M.S.,FAIS,FCD
Professor & Unit Chief
Department of General Surgery,
Madurai Medical College,
Madurai.

DECLARATION

I**, DR.NAWAZ USMAN solemnly** declare that the dissertation titled **"RISK-ADJUSTED ANALYSIS OF PATIENTS UNDERGOING EMERGENCY LAPAROTOMY USING POSSUM AND P-POSSUM PREDICTION MODELS"** has been prepared by me. This is submitted to **The Tamil Nadu Dr. M.G.R. Medical University, Chennai,** in partial fulfillment of the regulations for the award of MS degree (Branch I) General Surgery.

Place: Madurai **DR.NAWAZ USMAN**

Date:

ACKNOWLEDGEMENT

At the outset, I wish to express my sincere gratitude to our unit chief **Prof. Dr.A.SANKARAMAHALINGAM M.S., FAIS, FCD,** for his expert supervision and valuable suggestions. I wish to express my whole hearted thanks to our assistant Professors **Dr.S.Chitra M.S., D.G.O., Dr.C.Ganga Lakshmi M.S., Dr. Ashoka Chakravarthy M.S.,** for their constant encouragement and excellent guidance.

I extend my sincere gratitude to Professor**. Dr.S.Selvachidambaram M.S.,** for his valuable motivation and guidance.

I wish to thank **Prof.Dr. M.GOBINATH, M.S.,** Professor and Head of the Department of Surgery for his valuable guidance and advices. I am greatly indebted to **Prof.Dr. A.EDWIN JOE, M.D (FM), B.L.,** Dean, Madurai Medical College & Government Rajaji Hospital, Madurai for his kind permission to allow me to utilize the clinical material from the hospital.

I whole heartedly thank all the patients who willingly co-operated and rendered themselves for the study without which the study couldn't have been a reality.

CONTENTS

INTRODUCTION

Surgical audit is a very important but often neglected part of medical profession. Despite the importance of this key aspect of medical practice, it surprisingly finds very little place in the medical curriculum in our country.

The word ‘audit’ means ‘a formal examination of an organization’s or individual’s accounts or financial situation’.[1] If we replace the words ‘organization’ with ‘surgical team’ and ‘accounts or financial situation’ with ‘surgical outcomes or results’, it is exactly what surgical audit means.

Audit is now widely recognized as a fundamental and compulsory part of surgical practice for quality assurance to assure an outcome which aligns to internationally accepted norms.

A surgical audit involves:

- Collection and measurement of clinical activities and outcomes
- Analysis and comparison using standards, performance indicators and outcome parameters and
- A peer review process with a feedback mechanism to redress problems

The key feature of audit is that it involves reviewing actual surgical performance, including outcomes .[2]

There are various systems to predict the outcomes. Some of these systems are:

1. For predicting outcomes in trauma:
    - Glasgow coma scale
    - Leeds prognostic score for head injury
    - TRISS score (TRauma score, Injury Severity Score)

2. For predicting outcomes of surgeries:
    - American society of anesthesiology (ASA) classification
    - POSSUM scoring system (Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity)
    - Portsmouth modification of POSSUM (P-POSSUM)

3. For assessment for specific conditions:
    - TNM staging for malignancies
    - Ransons criteria for acute pancreatitis
    - Ann Arbor classification of lymphomas

AIMS OF THE STUDY

1. To examine the value of POSSUM and P-POSSUM equations in predicting mortality in patients undergoing emergency laparotomy.
2. To compare the accuracy of POSSUM and P-POSSUM in predicting the mortality of the patient.
3. To compare data between the two years of the study period and evaluate the performance of the surgical team concerned.

REVIEW OF LITERATURE

Clinical audit is one of the "keystones" of clinical governance. A surgical department that subjects itself to regular and comprehensive audit should be able to provide data to current and prospective patients about the quality of the services it provides, as well as reassurance to those who pay for and regulate health care. Well-organized audit should also enable the clinicians providing services to continually improve the quality of care they deliver.

For audit to be meaningful and useful it must, like research, be methodologically robust and have sufficient "power" to make useful observations; it would be easy to gain false reassurance about the quality of care by looking at outcomes in a small or "cherry-picked" group of straightforward cases. Audit can be conducted retrospectively or prospectively and, again like research, prospective audit has the potential to provide the most useful data, and routine prospective audit provides excellent opportunities for patient benefit.[22]

Traditionally, the measure of outcome of surgical procedures has been done using raw mortality and morbidity statistics. However, raw mortality and morbidity statistics give an inaccurate picture, as they are often affected by factors other than the surgeon's skills alone. The patient's general condition, the nature of the surgery, the presence of co-morbidities all influence the surgical outcome, and must be taken into account if quality of care is to be assessed satisfactorily. Some

form of risk adjusted analysis is necessary if performance is to be assessed meaningfully and objectively and to avoid the vagueness that often comes along with the subjective forms of assessment criteria.

In some diseases these difficulties have been overcome with scoring systems which give an objective assessment of the severity of the diseases, for example the Ransons criteria used in assessing the severity of acute pancreatitis. However, in general surgery, such scoring systems haven't always been adequate because:

- There is a lack of objective numerical assessment, instead subjective risk strata like high, medium and low are used
- All the complications are not taken into account
- They usually assess mortality alone
- Inability to incorporate all types of surgeries into one scoring system
- Difficulty in application

An ideal scoring system for surgical audit should:

- Assess mortality and morbidity objectively and uniformly
- Give consistent results
- Be quick and easy to use
- Incorporate all surgical procedures in both the emergency and elective settings

- Have a uniform consensus in usage of terminology
- Be accurate in predicting outcome
- Provide a precise framework of data to compare outcome between different hospitals

There are many scoring systems that predict the risk of mortality with varying degrees of accuracy. The best known and most widely used scoring system is the APACHE scoring system. However, APACHE is too complex for general use.

While all these scoring systems are used in generally sick patients, none are exclusively for surgical patients. In 1991, G. P. Copeland *et al* [4] devised a unique scoring system which was applicable to all surgical patients and predicted mortality and morbidity in surgical patients using a number of factors. They called it the Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity – POSSUM. They initially assessed 62 individual factors (48 preoperative and 14 operative and post operative factors). They did an analysis over a 6 month period to reduce the number of variables. Of these, 35 factors were assessed over a further 6 month period to produce the scoring system. Only significant independent factors were included in the final score design. Each of these factors was given values of 1, 2, 4 or 8.[16] Thus a 12 factor, four grade physiological score was developed. Any decrease in the number of variables below this level resulted in a loss of predictive ability for mortality or morbidity.

While this preoperative physiological score yields a statistically predictive risk of morbidity and mortality for the patients overall, there were intergroup variations depending on the nature of the surgical procedure. Analysis of all data enabled a 6 factor, operative severity score to be evolved which compensated for the type of surgical procedure.

A report from Whiteley et al in 1998 claimed that POSSUM over predicted death, especially in low-risk patients. In an effort to counteract this effect the original POSSUM equation was modified leading to the Portsmouth predictor equation for mortality (P-POSSUM) utilizing the same physiological and operative variables.[5]

Further studies have since shown the use of POSSUM and P-POSSUM to predict mortality equally well. Even the P-POSSUM model still overpredicts mortality in low-risk groups, but is a better 'fit' than POSSUM.

Since first published, the POSSUM scoring system has been validated by many authors.

In a study conducted by Mohil R S *et al* in India, 120 patients undergoing emergency laparotomy were taken into account. Predicted mortality and morbidity were calculated by POSSUM and P – POSSUM equations using both linear regression and the exponential methods of analysis and were compared with the

observed actual outcomes. When the linear method of analysis was used POSSUM over predicted morbidity. There was a significant difference between the observed and predicted values (observed to expected, O : E ratio was 0.68). The prediction was more accurate when the exponential method was used (O : E ratio 0.91). POSSUM also significantly over predicted mortality when analyzed by the linear method (O : E ratio 0.39), but the prediction improved when exponential analysis was used (O : E ratio 0.62). However P-POSSUM showed more consistent results. On applying linear and exponential analyses, the O : E ratios vastly improved those seen in the POSSUM equation calculations. The respective O : E ratios for mortality were 0.66 and 0.88. [6]

K V Menon *et al* conducted a prospective study with 173 patients who underwent colorectal resection for cancer to compare predicted versus observed mortality using P – POSSUM and to determine whether this scoring system predicted surgical outcomes correctly. The observed mortality rate was 8.7 percent compared with a P-POSSUM predicted rate of 15.6 percent. Observed morbidity was 29 percent whereas the predicted mortality rate was 32 percent. They concluded that P – POSSUM allows for risk standardization of patients. However, risk of postoperative mortality may be overestimated by the scoring system. [8]

Ramesh VJ *et al* evaluated POSSUM and P-POSSUM scoring systems for predicting the mortality in elective neurosurgical patients using 285 patients.

Overall observed mortality was nine patients (3.16%). The mortality predicted by the P-POSSUM model was also nine patients (3.16%). Mortality predicted by POSSUM was poor with predicted deaths in 31 patients (11%). The difference between observed and predicted deaths at different risk levels was not significant with P-POSSUM ($p = 0.424$) and was significantly different with POSSUM score ($p < 0.001$).they observed that P-POSSUM scoring system was highly accurate in predicting the overall mortality in neurosurgical patients. In contrast, POSSUM score was not useful for prediction of mortality. [11]

Poon *et al* studied the POSSUM and P-POSSUM scoring systems for predicting the mortality in surgery for obstructing colorectal cancer and correlated the predicted mortality with different surgical options. A total of 160 patients were included in the study and 18 patients died postoperatively. The operative mortality was 11.3 percent. P-POSSUM predicted overall mortality of 15 percent. The observed and predicted mortality was found to have no significant lack of fit (chi-squared = 5.98; degree of freedom = 3; P = 0.11). For patients with left-sided tumors, P-POSSUM predicted mortality and actual mortality of patients who had resection without anastomosis were both significantly higher than patients with single-stage resection and primary anastomosis (P = 0.044 and 0.011, respectively). They concluded that P-POSSUM system was valid for prediction of overall mortality in patients with operations for obstructing colorectal cancer. And

the estimation of P-POSSUM predicted mortality during operation and its ability to correlate with choice of procedure was an area that was worth further study in emergency colorectal surgery.[12]

However, these formulae weren't without pitfalls. The following were few of them:

- Impact of obesity and diabetes were ignored, despite the fact that diabetes has been clearly found to adversely affect postoperative outcomes.
- Some studies felt that scoring of some factors required subjective assessment.
- Some authors felt that there was duplication of certain similar risk factors in this scoring system.
- POSSUM was only suitable for patients undergoing operative treatment.
- Scoring of each patient required a chest radiograph, an electrocardiogram (ECG) and a blood sample for electrolytes. For many healthy patients all these tests are not necessary.
- The lowest physiological and operative scores are 12 and 6 respectively, which when applied to the POSSUM mortality predictor equation, give a

minimum risk of death 1.1 percent. This is far too high given that it represents the fittest individual undergoing the most minor surgery.

Furthermore, POSSUM and P – POSSUM failed to give consistent results when applied for surgical subspecialties. Owing to all these, several authors came up with their own modifications of POSSUM.

Modifications of POSSUM:

There have been reports of overprediction of mortality and morbidity by the POSSUM and P – POSSUM formulae when used in different surgical specialties. This has led some to produce specialty-specific POSSUM such as CR – POSSUM, V-POSSUM, O – POSSUM etc.

CR – POSSUM:

A slight modification of the POSSUM scoring system was devised and used for prediction of outcomes in patients undergoing colorectal surgeries. This was called the CR – POSSUM. It makes use of 6 physiological parameters and 4 operative parameters.[17]

Stephen J. Bromage and William J. Cunliffe studied the predictive ability of this scoring system and compared it with POSSUM and Portsmouth-POSSUM (P-POSSUM) models.

They studied it in 304 patients undergoing colorectal surgery. The overall operative mortality was 6.5 percent. Observed to expected ratios were used to compare the scoring systems at a given predicted mortality. The overall observed to expected ratio was 1.25 for CR-POSSUM, 1.59 for P-POSSUM, and 3.37 for POSSUM. After correcting for factors used in the CR-POSSUM, logistic regression showed a significant correlation between albumin and mortality ($P = 0.016$).

They concluded that the CR-POSSUM model was an accurate predictor of outcome for major colorectal surgery. The POSSUM and P-POSSUM models over-predicted mortality. Albumin, which was not a factor included in these three systems, could be an important addition in improving the accuracy of the CR-POSSUM model. [13]

O – POSSUM:

Another modification of the POSSUM scoring system was developed to suit patients undergoing oesophagogastric surgeries. This formula makes use of 12 physiological parameters and 3 operative parameters.[18]

J S Nagabhushan *et al* studied and compared O – POSSUM with P – POSSUM in 313 patients undergoing oesophagogastric resections. 32 died within

30 days (10.2%). P-POSSUM predicted 36 deaths standardized mortality ratio (SMR) of 0.89. O-POSSUM predicted 49 deaths giving an SMR of 0.65.

They concluded that P-POSSUM provided a better fit to observed results than O-POSSUM, which over predicted total mortality. P-POSSUM also had superior discriminatory power. [14]

Vascular – POSSUM:

Similarly a variation of the POSSUM scoring system was developed for vascular surgeries by Prytherch *et al*[16] in 2001. It makes use of 12 physiological parameters and 6 operative parameters.[19]

MATERIALS AND METHODS

INCLUSION CRITERIA:

All emergency laparotomies performed in sixth surgical unit, GRH Madurai.

EXCLUSION CRITERIA:

1. Patients whose data were incomplete.
2. Patients lost to follow up.

STUDY DESIGN:

It was a prospective study.

STUDY PERIOD:

The study was conducted over a period of two years between December 2009 and November 2011.

DATA COLLECTION:

All necessary data was collected prospectively on a proforma sheet. The physiological data were entered in the proforma sheets as and when they were available and the operative findings were collected from the operative notes.

PROFORMA:

Name: Age/Sex: Hosp.No:

IP No: Diagnosis:

D.O.A:

D.O.S:

DOD:

Address:

PHYSIOLOGICAL CRITERIA:

1 .Age:

2. Cardiac signs:

a) H/o taking any of the following drugs YES/NO

If yes i) Anti diuretics yes/no

ii) Anti anginal agents yes/no

iii) Digoxin yes/no

iv) Warfarin yes/no

b) H/o or signs of pedal oedema YES/NO

c) Raised JVP YES/NO

d) Cardiomegaly on chest X ray YES/NO

If yes borderline/overt

3. Respiratory signs:

a) H/o dyspnoea YES/NO

If yes i) Dyspnoea on exertion yes/no

ii) Limiting dyspnoea yes/no

iii) Dyspnoea at rest yes/no

b) On Chest X-ray

Normal yes/no

If no Mild COAD yes/no

Moderate COAD yes/no

Fibrosis/consolidation yes/no

4. Blood Pressure (systolic):

5. Pulse Rate (per minute):

6. Glasgow coma scale:

7. Haemoglobin (g/100ml)

8. WBC count:

9. Serum Urea (mmol/L):

10. Serum Sodium (mmol/L):

11. Serum Potassium (mmol/L):

12. ECG:

Normal	yes/no
Atrial fibrillation (60-90/min)	yes/no
≥ 5 ectopics/min	yes/no
Q waves	yes/no
ST/T waves	yes/no

Any other abnormality-

OPERATIVE CRITERIA:

Operative procedure done:

1. Operative severity: Minor / Moderate / Major / Major+
2. Multiple procedures:
3. Total blood loss:
4. Peritoneal soiling: None / Serous fluid /Blood / Pus / Bile/Faecal matter
5. Presence of malignancy: Yes/No

If death: Date and time:

Cause of death:

Physiological score:

Operative score:

POSSUM predicted mortality:

P – POSSUM predicted mortality:

PHYSIOLOGICAL SCORE:

	Score			
	1	**2**	**4**	**8**
Age (in years)	≤60	61-70	≥71	
Cardiac signs	No failure	Diuretic, Digoxin, anti anginal, or antihypertensive therapy	Peripheral edema, warfarin therapy, borderline cardiomegaly	Raised JVP, cardiomegaly
Respiratory signs	No dyspnoea	Dyspnoea on exertion, mild COPD	Limiting Dyspnoea (one flight), moderate COPD	Dyspnoea at rest (rate ≥ 30/min), fibrosis or consolidation
Blood pressure (systolic in mmHg)	110 - 130	131 - 170 100 - 109	≥ 171 90 - 99	≤ 89
Pulse (beats/min)	50 - 80	81 - 100 40 - 49	101 - 120	≥ 120 ≤ 39
Glasgow coma scale	15	12 - 14	9 - 11	≤ 8
Hemoglobin	13 - 16	11.5 – 12.9 16.1 – 17.0	10.0 – 11.4 17.1 – 18.0	≤ 9.9 ≥ 18.1
White cell count (X 10^{12}/L)	4 - 10	10.1 – 20.0 3.1 – 4.0	≥ 20.1 ≤ 3.0	
Urea (mg/dl)	≤ 40	41 – 55	55 – 80	≥ 80
Sodium (mmol/L)	≥ 136	131 - 135	126 - 130	≤ 125
Potassium (mmol/L)	3.5 – 5.0	3.2 – 3.4 5.1 – 5.3	2.9 – 3.1 5.4 – 5.9	≥ 6.0
ECG	Normal		Atrial fibrillation	Any abnormal rhythm or ≥ 5 ectopics/min, Q waves or ST/T wave changes

OPERATIVE SEVERITY SCORE:

	Score			
	1	2	4	8
Operative severity	Minor	Moderate	Major	Major +
Multiple procedures	1		2	> 2
Total Blood loss (ml)	≤ 100	101 - 500	501 - 999	≥ 1000
Peritoneal soiling	None	Minor (serous fluid)	Local pus	Free bowel content, pus or blood
Presence of malignancy	None	Primary only	Nodal metastases	Distant metastases
Mode of surgery			Emergency resuscitation or > 2 hrs possible Operation within 24 hours after admission	Emergency (immediate surgery < 2 hrs needed)

The following were some of the criteria used in scoring:

- Patients undergoing more than one procedure within a period of 30 days were considered to have undergone multiple procedures.
- The blood loss during surgery was assessed by counting mops and the volume of suction fluid.

- Border line cardiomegaly means that the heart is at the upper limits of normal whereas cardiomegaly means that the heart is enlarged. In reality this means that if there is border line cardiomegaly the patient has a degree of heart failure which might be detectable by the presence of oedema. Overt cardiomegaly is usually associated with a raised JVP.

- The degree of scarring or the presence of emphysematous change on chest X-ray usually detects mild and moderate chronic obstructive airway disease (COAD). Any overt signs of pneumonia or significant collapse were given a score of 8.

Any post operative mortality and the cause for the same were duly noted.

The GCS criteria used was:

Score	**Eyes open**	**Verbal**	**Motor**
1	Spontaneous	Converses/Oriented	Obeys
2	To speech	Converses/Disoriented	Localizes pain
3	To pain	Inappropriate	Withdraws (flexion)
4	Absent	Incomprehensible	Decorticate (flexion) rigidity
5		Absent	Decerebrate (extension) rigidity
6			Absent

According to the original definitions of Copeland *et al* [4], the operative severity was categorised as:

Moderate surgery: Cholecystectomy, appendicectomy, mastectomy, TURP. **Major surgery:** any laparotomy, bowel resection, cholecystectomy with choledochotomy, peripheral vascular procedure or major amputation. **Major+ surgery:** any aortic procedure, abdominoperineal resection, pancreatic or liver resection, oesophagogastrectomy. [2]

As all our cases were laparotomies and we dint come across any emergency procedure falling within the Major+ surgery category, all our cases were in the Major category and were assigned the appropriate score.

The values were entered into a POSSUM and P – POSSUM calculator [21] obtained from the internet and the physiological and operative scores as calculated by the calculator were noted down.

The maximum possible physiological score is 88 and minimum score is 12. The maximum possible operative score is 48 and minimum is 12.

The risk of mortality was calculated using POSSUM and P-POSSUM formulae.

POSSUM equation for postoperative mortality:

Ln R/1-R = -7.04 + (0.13 x physiological score) + (0.16 x operative severity score)

P – POSSUM equation for postoperative mortality:

Ln R/1-R = -9.065 + (0.1692 x physiological score) + (0.1550 x operative severity score)

Where R = predicted risk of mortality

The mortality percentages were calculated using the above mentioned calculator obtained from the internet and the values were duly noted in a table made using Microsoft Excel.

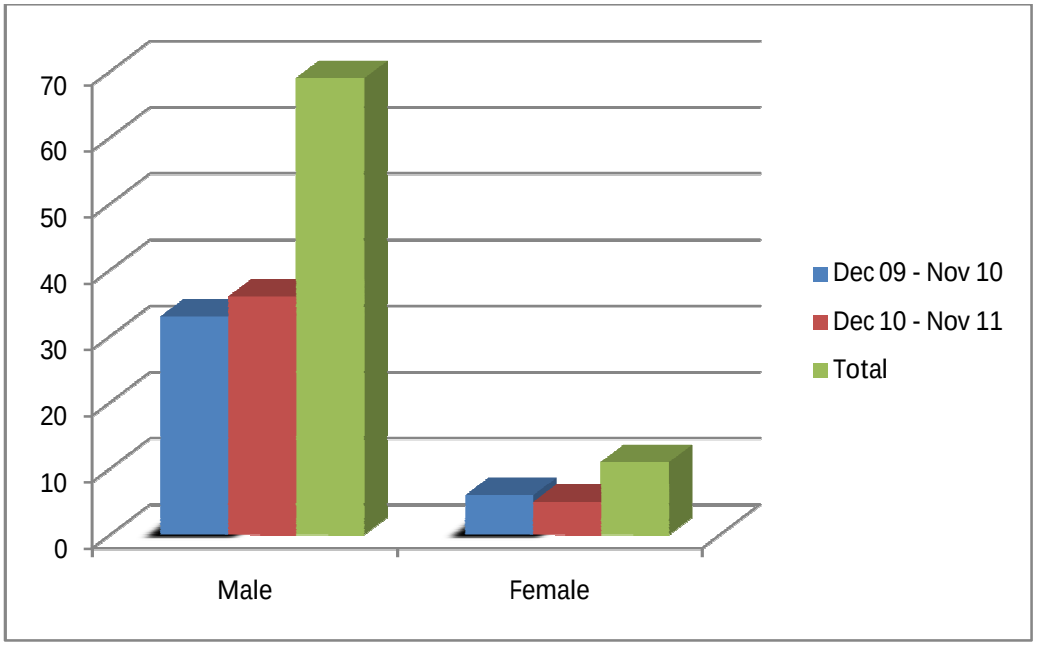
The data was analysed using both linear and exponential methods of analysis. The ratio of observed and expected mortality (O:E ratio) was calculated using the analysis. The O:E ratio was compared by means of Chi squared test [15]. A 'P' value of less than 0.05 was considered significant.

RESULTS

Our study period was from December 2009 to November 2011. During this period we performed 138 emergency laparotomies in our unit. Out of which 80 cases fulfilled our inclusion criteria. We further broke down the study period into two time periods, December 2009 – November 2010 and December 2010 – November 2011 in order to compare our performance between the two time periods.

The study included 69 male and 11 female patients.

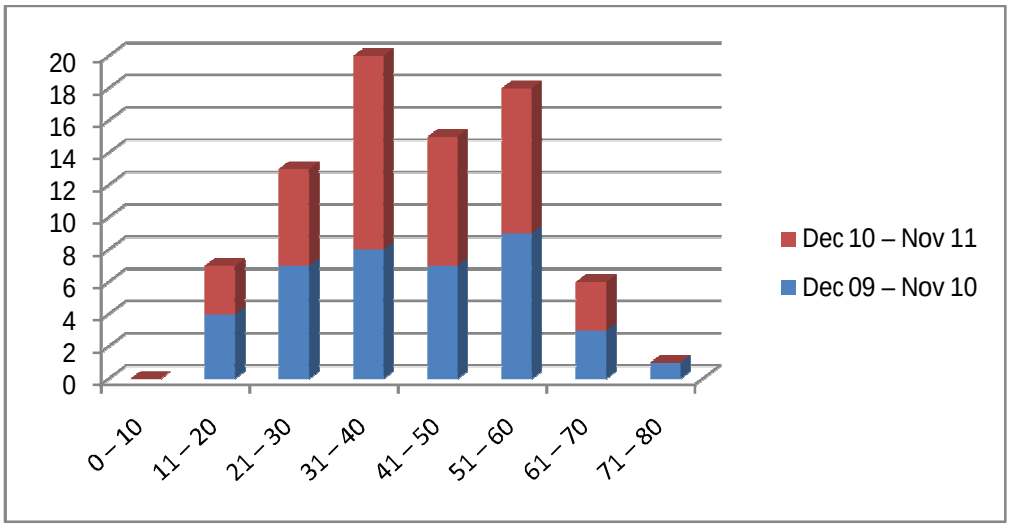
	Dec 09 – Nov 10	**Dec 10 – Nov 11**	**Total**
Male	33	36	69
Female	6	5	11
Total	39	41	80



Age distribution:

	Dec 09 – Nov 10	Dec 10 – Nov 11	Total
0 – 10	0	0	0
11 – 20	4	3	7
21 – 30	7	6	13
31 – 40	8	12	20
41 – 50	7	8	15
51 – 60	9	9	18
61 – 70	3	3	6
71 – 80	1	0	1
Total	39	41	80

We had patients in the age range of 19 to 80 yrs, with a mean age of 41.3 years.



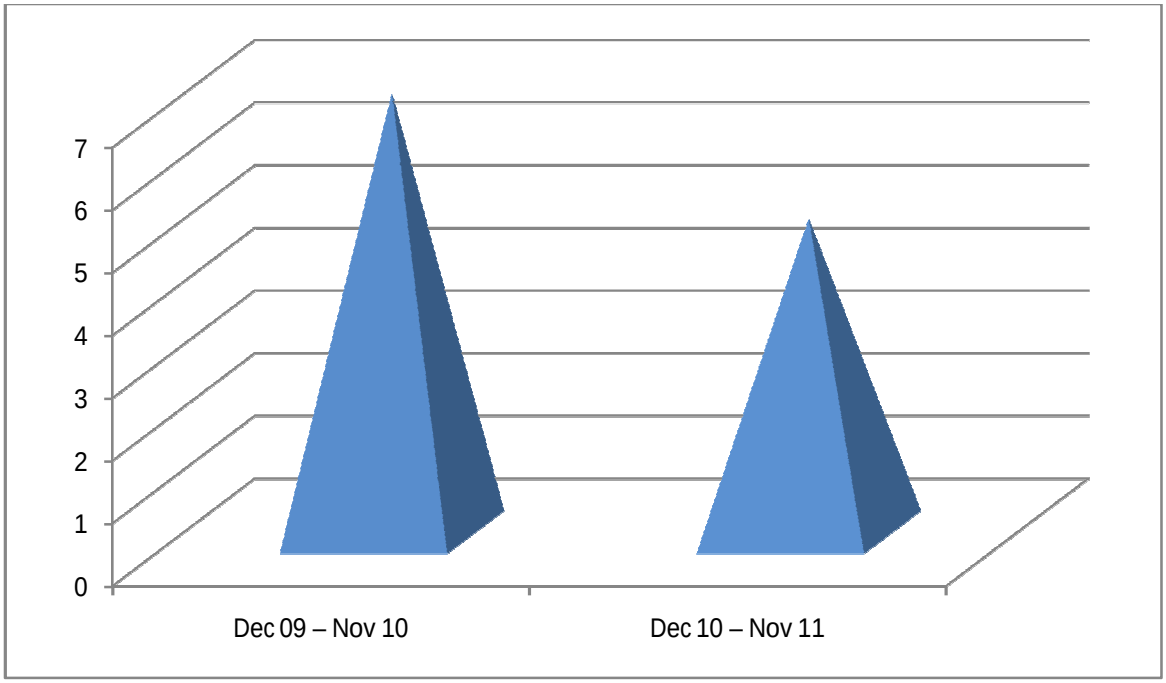
There were two peaks in the age ranges 31-40 and 51-60, the former owing to the relatively large number abdominal traumas in that age group and the latter

due to the large number of perforation peritonitis and intestinal obstruction pathologies.

OUTCOMES:

Out of the 80 patients, we had 12 deaths in our study group.

	Dec 09 – Nov 10	**Dec 10 – Nov 11**	**Total**
No. of Deaths	7	5	12



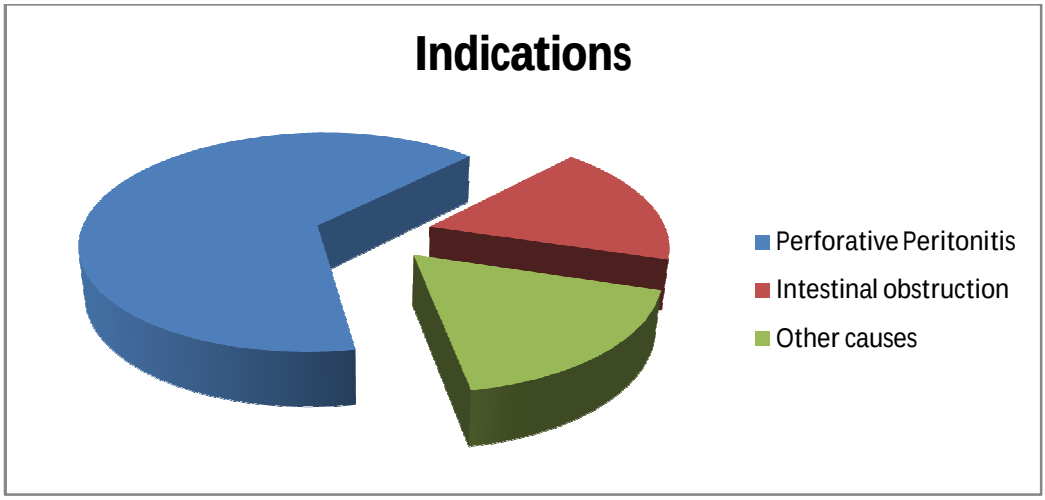
We observed that a whopping 58 patients out of 80 (72.5%) had hemoglobin levels below 10. This is probably a reflection of the fact that our institute caters

mainly to a population in the low socioeconomic status. And naturally the POSSUM equation predicted higher mortality in our patients when we compared our data with similar studies done in other institutions.

INDICATIONS FOR EMERGENCY LAPAROTOMY:

The two main indications for laparotomy in our study group were perforative peritonitis and intestinal obstruction.

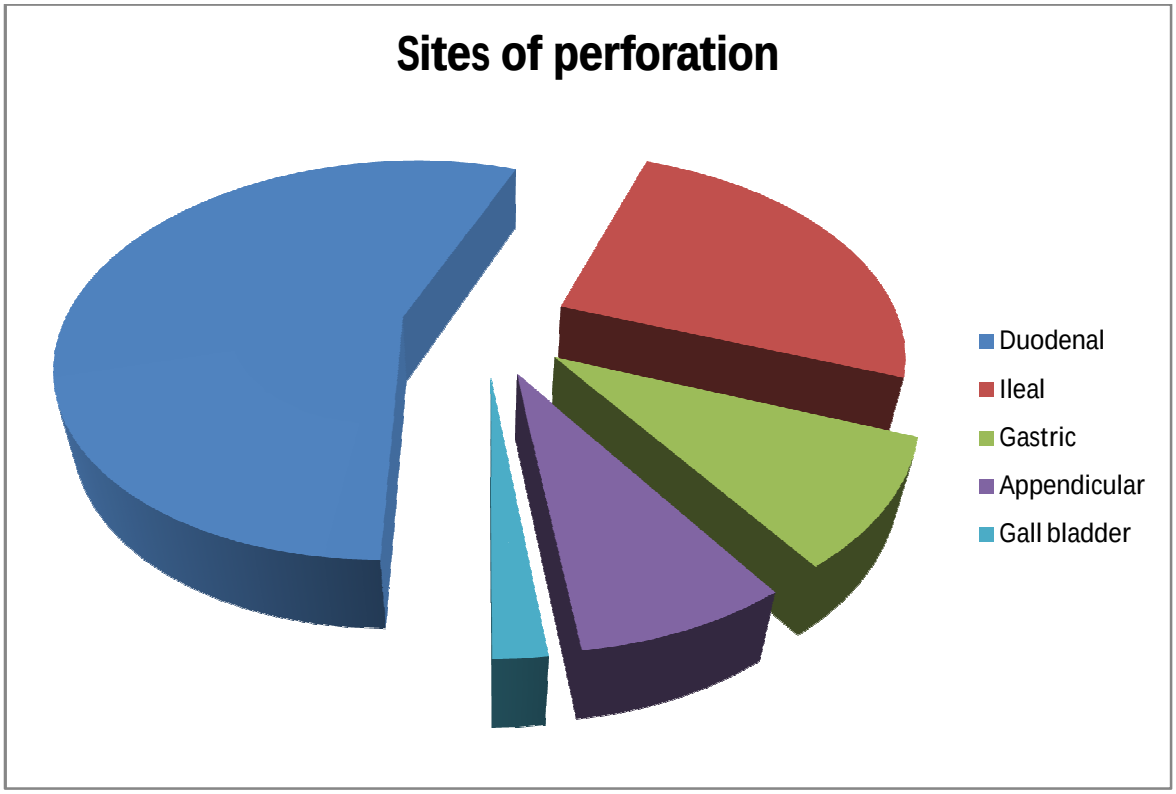
Indications	**Number**
Perforative Peritonitis	52
Intestinal obstruction	14
Other causes	14



Perforative peritonitis:

PERFORATIVE PERITONITIS	No. of patients
Duodenal	29
Ileal	13
Gastric	5
Appendicular	4
Gall bladder	1
Total	52

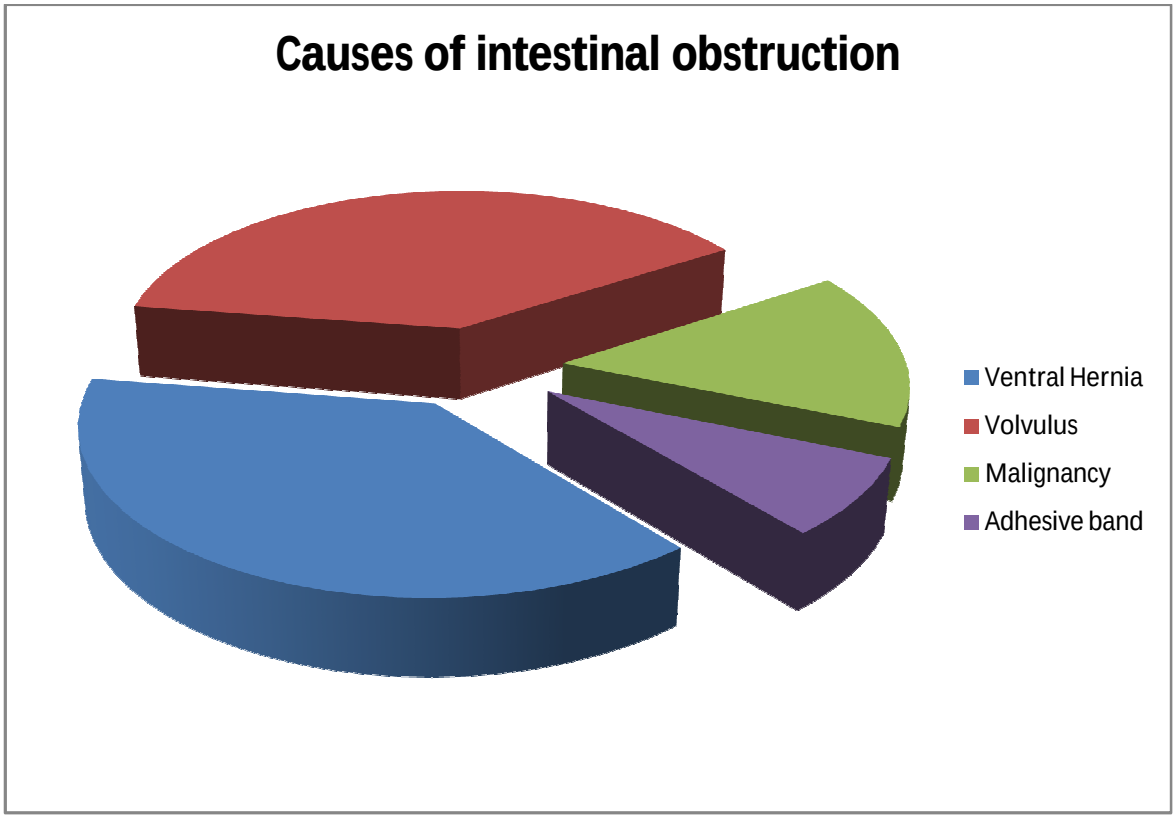
52 out of the 80 (65%) cases in our study group were cases of perforative peritonitis, with duodenum being the most common site followed by ileum.



Intestinal obstruction:

Intestinal obstruction was the indication in 14 out of 80 cases (17.5%).

INTESTINAL OBSTRUCTION	No. of patients
Ventral Hernia	5
Volvulus	5
Malignancy	2
Adhesive band	1
Ileocaecal Tuberculosis	1
Total	14



Other causes:

Causes	**No. of patients**
Blunt Injury	6
Stab Injury	6
Ileo-ileal intussusception	1
Ruptured Liver abscess	1
Total	14

Although our study group contained only 6 cases each of blunt and stab injuries, we see a higher number of these cases in our setup. Since these patients are apparently healthy otherwise and often young individuals, they are taken up for laparotomy with the bare minimum workup necessary. Hence only 12 of the cases met our inclusion criteria.

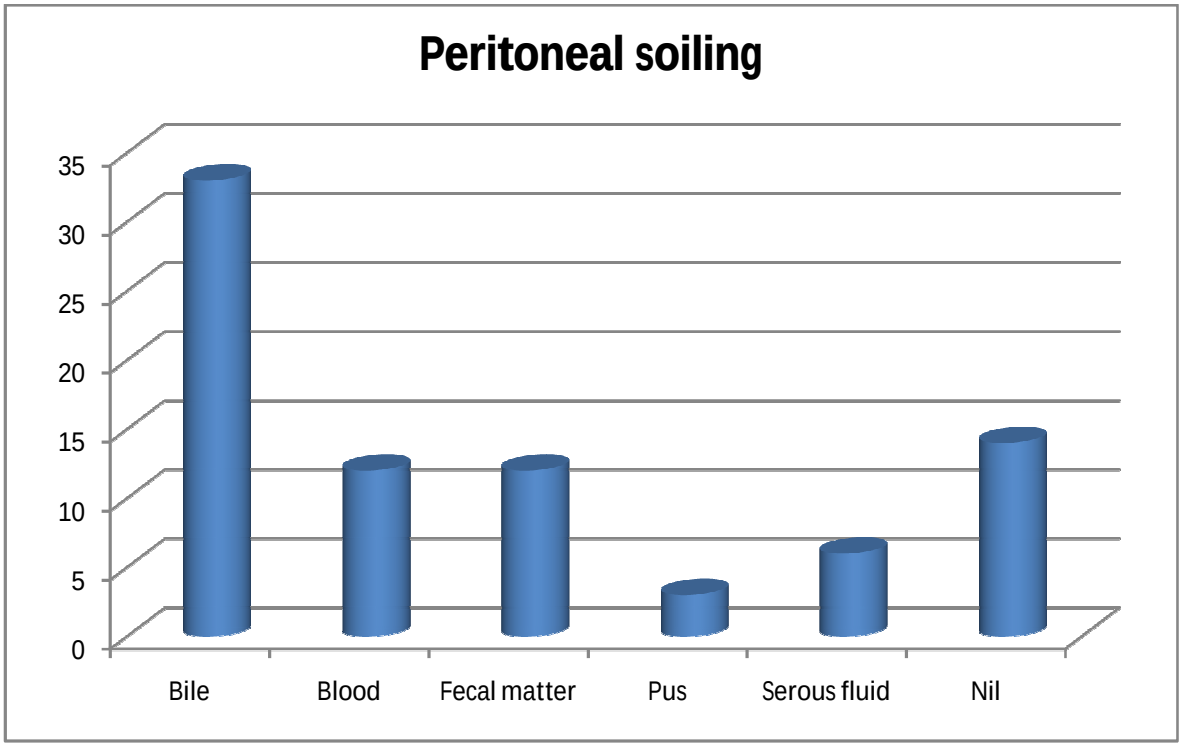
Operative severity:

As all our cases were laparotomies, they came under the Major category and were assigned the appropriate score.

Peritoneal soiling:

66 out of 80 patients (82.5) had peritoneal soiling.

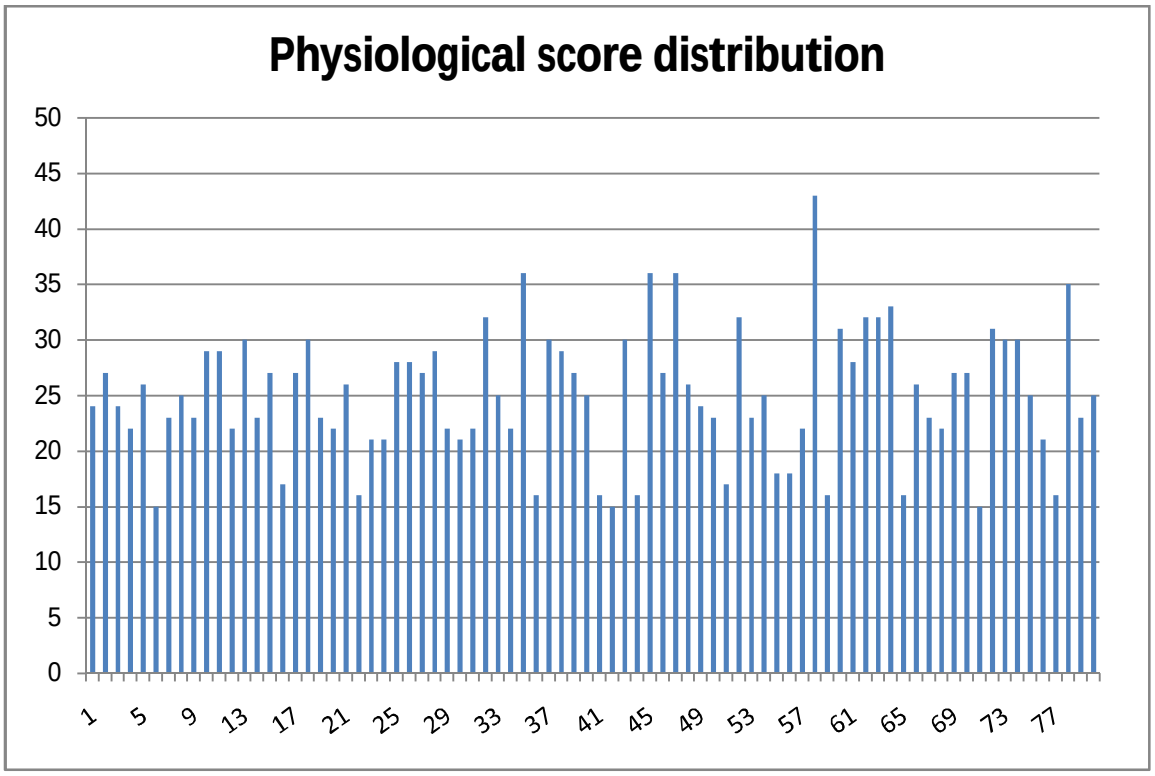
Peritoneal content	No.
Bile	33
Blood	12
Fecal matter	12
Pus	3
Serous fluid	6
Nil	14



Results:

Physiological score:

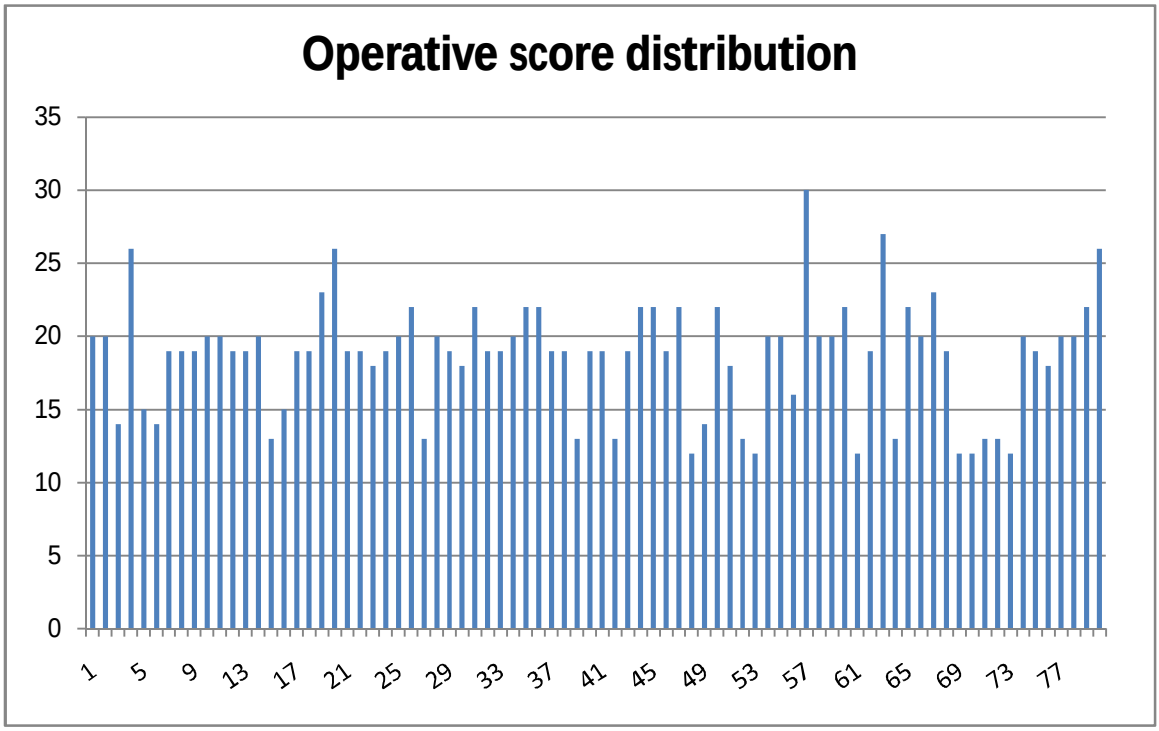
The physiological scores ranged from 15 to 48, the mean score being 25.02.



The physiological scores in our study group was skewed towards the higher side due to the low hemoglobin levels and due to the fact that the major chunk of our study group had varying degrees of pre-renal failure at presentation due either to blood loss as in traumas or due to underlying sepsis as in cases of perforative peritonitis or intestinal obstruction.

Operative score:

The operative scores ranged from 12 to 30 with a mean score of 18.71.



Most of our patients had peritoneal contamination in the form of fecal, biliary contamination or pus collections, pushing the operative scores up resulting in an increase in the number of predicted deaths.

POSSUM:

Using the physiological and operative scores obtained using the formula for POSSUM the predicted mortality rates were calculated. The observed and the expected mortality (O:E ratio) was calculated by using both linear and exponential analysis.

Linear analysis:

Predicted mortality rate %	**No. of patients**	**Predicted no. of deaths** *	**Observed no. of deaths**	**O:E ratio**
0-10	5	0	0	0
11-20	22	4	1	0.25
21-30	10	3	0	0
31-40	18	6	2	0.33
41-50	12	6	3	0.5
51-60	4	2	2	1
61-70	7	4	2	0.5
71-80	1	1	1	1
81-90	1	1	1	1
91-100	0	0	0	0
0-100	80	27	12	0.44

* rounded off to the nearest whole number

The number of deaths predicted by POSSUM with linear analysis was 27, when the actual observed number of deaths was only 12. The O:E ratio was 0.44 and it significantly over predicted mortality ($P < 0.05$) .

Exponential analysis:

Predicted mortality rate %	No. of patients	Predicted no. of deaths *	Observed no. of deaths	O:E ratio
0-29	36	6	1	0.16
10-29	32	6	1	0.16
20-29	9	2	0	0
30-69	42	19	10	0.52
40-69	25	13	8	0.61
50-69	11	7	4	0.57
60-69	7	4	2	0.5
70-100	2	2	2	1
80-100	1	1	1	1
90-100	0	0	0	0
0-100	80	25	12	0.48

* rounded off to the nearest whole number

The number of deaths predicted by POSSUM with exponential analysis was 25, which still remained far higher than the actual observed number of 12. The O:E ratio was 0.48 and the over prediction remained statistically significant ($P < 0.05$).

P – POSSUM:

Using the physiological and operative scores obtained using the formula for P – POSSUM the predicted mortality rates were calculated for both the time periods i.e. Dec 09 – Nov 10 and Dec 10 – Nov 11.the observed and the expected mortality (O:E ratio) was calculated by using both linear and exponential analysis.

Linear analysis:

Predicted mortality rate %	**No. of patients**	**Predicted no. of deaths** *	**Observed no. of deaths**	**O:E ratio**
0-10	34	2	1	0.5
11-20	20	3	2	0.6
21-30	9	2	2	1
31-40	10	4	4	1.33
41-50	3	1	1	1
51-60	2	1	0	0
61-70	1	1	1	1
71-80	0	0	0	0
81-90	1	1	1	1
91-100	0	0	0	0
0-100	80	15	12	0.8

* rounded off to the nearest whole number

The number of deaths predicted by P – POSSUM with linear analysis was 15, as against the actual observed number of 12. The O:E ratio was 0.8 and the over prediction was insignificant ($P > 0.05$) .

Exponential analysis:

Predicted mortality rate %	No. of patients	Predicted no. of deaths *	Observed no. of deaths	O:E ratio
0-29	62	6	5	0.83
10-29	32	4	4	1
20-29	10	2	2	1
30-69	17	6	6	1
40-69	6	3	2	0.66
50-69	3	2	1	0.5
60-69	1	1	1	1
70-100	1	1	1	1
80-100	1	1	1	1
90-100	0	0	0	0
0-100	80	14	12	0.88

* rounded off to the nearest whole number

The number of deaths predicted by P – POSSUM with exponential analysis was 14. The O:E ratio slightly improved to 0.88. The over prediction was statistically insignificant ($P > 0.05$).

Comparison of our performance between the two years

We split the overall data into two halves of one yr each, the first between December 2009 – November 2010 and second between December 2010 – November 2011, in order to compare our performance.

We compared the P – POSSUM mortality values obtained for each set of data using both linear and exponential methods of analysis.

Linear analysis:

Dec 09 – Nov 10:

Predicted mortality rate %	**No. of patients**	**Predicted no. of deaths***	**Observed no. of deaths**	**O:E ratio**
0-10	18	1	1	1
11-20	9	1	1	1
21-30	3	1	1	1
31-40	6	2	2	1
41-50	1	0	1	0
51-60	1	1	0	0
61-70	1	1	1	1
71-80	0	0	0	0
81-90	0	0	0	0
91-100	0	0	0	0
0-100	39	7	7	1

* rounded off to the nearest whole number

Dec 10 – Nov 11:

Predicted mortality rate %	**No. of patients**	**Predicted no. of deaths***	**Observed no. of deaths**	**O:E ratio**
0-10	16	1	0	0
11-20	11	2	1	0.5
21-30	5	1	1	1
31-40	5	2	2	1
41-50	2	1	0	0
51-60	1	0	0	0
61-70	0	0	0	0
71-80	0	0	0	0
81-90	1	1	1	1
91-100	0	0	0	0
0-100	41	8	5	0.62

* rounded off to the nearest whole number

On applying the linear analysis, the O:E ratio decreased from 1 to 0.62 across the two halves of the study period, meaning we had fewer deaths than expected in the second half of our study.

Exponential analysis:

Dec 09 – Nov 10:

Predicted mortality rate %	**No. of patients**	**Predicted no.***	**Observed no.**	**O:E ratio**
0-29	30	3	3	1
10-29	14	2	2	1
20-29	4	1	1	1
30-69	9	4	4	1
40-69	3	2	2	1
50-69	2	1	1	1
60-69	1	1	1	1
70-100	0	0	0	0
80-100	0	0	0	0
90-100	0	0	0	0
0-100	39	7	7	1

* rounded off to the nearest whole number

Dec 10 – Nov 11:

Predicted mortality rate %	No. of patients	Predicted no.*	Observed no.	O:E ratio
0-29	32	4	2	0.5
10-29	18	3	2	0.66
20-29	6	1	1	1
30-69	8	3	2	0.66
40-69	3	1	0	0
50-69	1	1	0	0
60-69	0	0	0	0
70-100	1	1	1	1
80-100	1	1	1	1
90-100	0	0	0	1
0-100	41	9	5	0.55

* rounded off to the nearest whole number

The same observation was made on applying the exponential method of analysis, our actual observed no. of deaths were lower than that expected.

One other observation was the fact that, contrary to most authors who claim exponential analysis to be better than linear, in these two sets of data, we found that the linear method of analysis was slightly better.

However, when the overall data was studied, as shown previously, exponential analysis was still better, as has been shown by almost all the studies we found on reviewing the literature.

DISCUSSION AND ANALYSIS

Surgical audit is a very important albeit neglected part of surgical practice, more so in this era of litigations, not only to protect ourselves from the unwanted problems, but also to provide quality care to patients.

Morbidity and mortality rates continue to be the main end points by which quality of care is judged. However, the measurement of these parameters is bound to be biased due to a host of factors. Operative mortality will vary between surgical teams for multiple reasons; case-mix, co-morbid disease, type of presentation etc being the most relevant and important measure. Sub-optimal surgical care is not the only reason for varying mortality rates. Risk stratification by the use of mortality prediction models has the potential to compensate for the above factors and therefore allow a better means of comparing performance between hospitals. This is not a new concept, Florence Nightingale made note of this over a hundred years ago:

"In the first place, different hospitals receive very different proportions of the same class of diseases. The ages in one hospital may differ considerably from the ages in another. And the state of the cases on admission may differ very much in each hospital. These elements affect considerably the result of treatment altogether apart from the sanitary state of hospitals".

However, to be of use in surgical audit, these prediction models must produce a valid assessment of the risk of mortality and morbidity. They should be inclusive of all types of surgeries and be easily applicable and should return consistent results. Such a prediction model would be a valuable tool in surgical audit to review and compare performances between surgical teams, and for self assessment and make improvements, if and when they are needed.

In the past, various scoring systems, such as ASA and APACHE have been used to predict both morbidity and mortality in surgical patients. However, ASA is too simplistic and highly subjective whilst APACHE is too complex for general use. POSSUM and P – POSSUM scoring systems proved useful for comparative audit and have been validated in numerous studies.

We conducted a two year prospective study to assess the usefulness of POSSUM and P – POSSUM prediction models in predicting mortality in patients undergoing emergency laparotomies. We compared our study with two other similar studies done on emergency laparotomies. A study done by Mohil RS *et al* included 120 patients over a period of one year. Another study done in KMC Manipal included 82 patients. We studied 80 emergency laparotomies over a period of 2 years.

	Our study	KMC Manipal	Mohil et al
Total no. studied	80	82	120
No. of deaths	12 (15%)	8 (9.75%)	16 (13.3%)

In our study, as in the study by Mohil et al, all the cases fell under the Major category, where as in the Manipal study there were two cases under the Major+ category.

We dint have any patient undergoing a second subsequent laparotomy, unlike the other two studies, both of which had patients undergoing second laparotomies.

In total, 82.5% of our cases had peritoneal soiling as against 72% in the Manipal study and 65% in the study by Mohil et al. This could explain why our mortality percentage was slightly higher compared to the other studies.

Comparing the indications, perforative peritonitis far outnumbered the other indications for emergency laparotomy in our study.

	Our Study	KMC Manipal
Perforative peritonitis	52	34
Intestinal obstruction	14	28
Other causes	14	20

Result analysis:

The expected no. of deaths as given by the POSSUM and P – POSSUM equations were compared with the observed no. of deaths as the observed: expected (O:E) ratio. If the O:E was more than 1, the formula under predicted deaths and if it was less than , it over predicted deaths. If it was equal to 1, it correctly predicted mortality.

The physiological and operative scores were used to calculate the predicted mortality rates using the POSSUM and P – POSSUM equations and then the predicted number in each group of patients was calculated by linear and exponential analysis. The observed and expected ratios of each individual group and finally the overall study group were calculated.

The χ^2 test was applied and the probability (P) was calculated. The result was considered significant if the probability (P) was < 0.05.

POSSUM:

The O:E ratio by linear analysis was 0.44 and there was over prediction of deaths and it was statistically significant ($P < 0.05$). When the prediction was done by exponential analysis, the O:E ratio mildly improved to 0.48, but there was over prediction again and it was again statistically insignificant ($P < 0.05$).

	Our study		KMC Manipal		Mohil et al	
Type of analysis	Linear	Exp.	Linear	Exp.	Linear	Exp.
O:E Ratio	0.44	0.48	0.47	0.67	0.39	0.62
P value	0.012	0.019	0.01	0.14	0.011	0.148
Prediction	Over predicted	Over predicted	Over predicted	Over predicted	Over predicted	Over predicted
Significance	Yes	Yes	Yes	No	Yes	No

In our study the over prediction was significant both by the linear and exponential analyses, as against the other two studies where the over prediction by the exponential method of analysis was insignificant.

P – POSSUM:

P – POSSUM predicted mortality equally well when the linear method was used, with an O:E ratio of 0.80 and no significant difference between the observed and predicted values (P > 0.05) was observed. The prediction improved when the exponential method was used, with an O:E ratio of 0.88 and no significant difference between the number of observed and predicted deaths (P > 0.05). This observation was comparable with that seen in the other two studies.

	Our study		KMC Manipal		Mohil et al	
Type of analysis	Linear	Exp	Linear	Exp	Linear	Exp
O:E Ratio	0.80	0.88	0.73	0.88	0.66	0.88
P value	0.89	0.95	0.82	0.95	0.619	0.966
Prediction	Over predicted	Over predicted	Over predicted	Over predicted	Over predicted	Over predicted
Significance	No	No	No	No	No	No

The POSSUM equation significantly over predicted mortality irrespective of the type of analysis used, linear or exponential. It gave consistently spurious results.

On the other hand, the P – POSSUM equation gave an accurate prediction with both the linear as well as exponential methods, the latter slightly better than the former.

If these findings can be validated in a larger set of data including all types of surgeries, it may be possible for individual surgeons, units and hospitals to analyze data using these prediction models to improve their services without having to rely on the use of crude mortality rates for assessing quality of care.

These models could also be used in the monthly mortality meets to see if any particular team has had more deaths than that was expected according to these prediction models. It could enable one to look into the possible reasons that might have caused this increase in mortality and undertake the appropriate corrective measures to prevent similar occurrences in the future, hence contributing ultimately to the improvement in the quality of health care provided.

POSSUM overprediction of mortality in lower risk groups

Furthermore, we observed that the overprediction of mortality by POSSUM was very high among the low risk groups, as has been documented by many authors. This very pitfall of POSSUM was the reason what prompted the modification of POSSUM into P – POSSUM (P for Portsmouth).

Predicted mortality rate %	**POSSUM**			**P – POSSUM**		
	Predicted no. of deaths	**Observed no. of deaths**	**O:E ratio**	**Predicted no. of deaths**	**Observed no. of deaths**	**O:E ratio**
0-10	**0**	**0**	**0**	**2**	**1**	**0.5**
11-20	**4**	**1**	**0.25**	**3**	**2**	**0.6**
21-30	**3**	**0**	**0**	**2**	**2**	**1**
31-40	**6**	**2**	**0.33**	**4**	**4**	**1.33**
41-50	**6**	**3**	**0.5**	**1**	**1**	**1**
51-60	2	2	1	1	0	0
61-70	4	2	0.5	1	1	1
71-80	1	1	1	0	0	0
81-90	1	1	1	1	1	1
91-100	0	0	0	0	0	0
0-100	27	12	0.44	15	12	0.8

The above table shows that the POSSUM equation predicted as many as 4 deaths in the group with predicted mortality rate 11-20, when actually there was only 1 death observed in the group. This trend was consistently observed with other low risk groups also. P – POSSUM, in comparison, fared better in these groups.

Self assessment:

	Linear analysis		Exponential analysis	
	Dec 09 – Nov 10	**Dec 10 – Nov 11**	**Dec 09 – Nov 10**	**Dec 10 – Nov 11**
Total no. studied	39	41	39	41
Observed no. of deaths	7	5	7	5
Expected no. of deaths	7	8	7	9
O:E ratio	1	0.62	1	0.55

As the above table shows, the P – POSSUM equation predicted 7 deaths, both according to linear as well exponential methods analyses, in the first yr of our study which was the same as the observed number. However, in the second yr of study, we had only 5 deaths, as against the predicted numbers of 8 (linear analysis) and 9 (exponential analysis). This shows that our performance in the second yr of study was better, assuming that P – POSSUM was consistent. This goes to show that the prediction model could be a valuable tool in self assessment.

However, it is evident from the above table that exponential method of analysis wasn’t any better than the linear method in the above set of data. This finding is in contradiction to the observation made by the other two studies and our own analysis of the overall data where exponential method of analysis consistently scored over the linear method.

CONCLUSIONS

1. The POSSUM equation significantly over predicted mortality irrespective of the method of analysis used.

2. The P-POSSUM equation prediction of mortality was good in both linear and exponential analysis.

3. P-POSSUM equation is a better predictor of mortality than POSSUM both in linear and exponential method of analysis.

4. Both the scoring systems over predicted mortality, POSSUM significantly so. Neither under predicted.

5. On comparing the two subsets of data, we found that our performance improved over the time period. We had fewer deaths than expected in the second half of our study period.

BIBLIOGRAPHY

1. Merriam – Webster Dictionary.
2. Surgical audit and peer review: A guide by Royal Australasian College of surgeons, 3rd edition, 2008; 3-4.
3. Copeland GP. The POSSUM system of surgical audit. *Arch Surg 2002;*137: 15-19
4. Copeland GP, Jones Dewaters M. POSSUM: a scoring system for surgical audit. *Br J Surg* 1991; 78:356-60.
5. Whitely MS, Prytherch DR, Higgins B, Weaver PC, Prout WG, Powell JS. POSSUM and Portsmouth – POSSUM for predicting mortality. *Br J Surg* 1998; 85:1217-20.
6. Mohil RS *et al*. POSSUM and P-POSSUM for risk adjusted audit of patients' emergency laparotomy.*Br J Surg* 2004 Apr; 91(4):500-503.
7. Copeland GP. The POSSUM system of surgical audit. *Arch Surg* 2002;137:15-19
8. Menon KV *et al*. An analysis of the accuracy of the P-POSSUM scoring for mortality risk assessment after surgery for colorectal cancer. *Colorectal Disease*; 4: 197-200.

9. Menon KV *et al.* Surgical patients with methicillin resistant Staphylococcus aureus infection: an analysis of outcome using P-POSSUM.J R Coll Surg Edinb, June 1999; 44: 161-163.
10. Copeland GP. Assessing the surgeon: 10 year's experience with the POSSUM system *J Clin Excellence* 2000; 2: 187-190.
11. Ramesh VJ, Rao GS, Guha A, Thennarasu K. Evaluation of POSSUM and P-POSSUM scoring systems for predicting the mortality in elective neurosurgical patients. *Br J Neurosurg.* 2008 Apr; 22(2):275-8.
12. Poon JTC, Chan B, Law WL. Evaluation of P-POSSUM in surgery for obstructing colorectal cancer and correlation of the predicted mortality with different surgical options. *Diseases of the Colon and Rectum*, 2005, v. 48 n. 3, p. 493-498.
13. Bromage SJ, Cunliffe WJ. Validation of the CR-POSSUM Risk-Adjusted Scoring System for Major Colorectal Cancer Surgery in a Single Center. *Diseases of the colon and rectum*, Volume 50, Number 2, 192-196
14. Nagabhushan JS, Srinath S, Weir S, Angerson WJ, Sugden BA, Morran CG. Comparison of P-POSSUM and O-POSSUM in predicting mortality after oesophagogastric resections. *Postgrad Med J 2007,* Vol. 83:355-358
15. Hosmer D, Lemeshow S: *Applied Logistic Regression.* 2nd edition. New York: John Wiley; 2000.
16. www.riskprediction.org-uk/background.php

17. www.riskprediction.org-uk/index-cr.php

18. www.riskprediction.org-uk/op-index.php

19. www.riskprediction.org-uk/vasc-index.php

20. www.riskprediction.org-uk/pp-index.php

21. www.vasgbi.com/riskpossum.htm

22. Sinclair A, Bridgewater B. How to set up a prospective surgical audit. *Principles of surgical audit,* www.blackwellpublishing.com.

PROFORMA:

Name: Age/Sex: Hosp.No:

IP No: Diagnosis:

D.O.A:

D.O.S:

DOD:

Address:

Physiological criteria:

1 .Age:

2. Cardiac signs:

a) H/o taking any of the following drugs YES/NO

If yes i) Anti diuretics yes/no

ii) Anti anginal agents yes/no

iii) Digoxin yes/no

iv) Warfarin yes/no

b) H/o or signs of pedal oedema YES/NO

c) Raised JVP YES/NO

d) Cardiomegaly on chest X ray YES/NO

If yes borderline/overt

3. Respiratory signs:

a) H/o dyspnoea YES/NO

If yes i) Dyspnoea on exertion yes/no

ii) Limiting dyspnoea yes/no

iii) Dyspnoea at rest yes/no

b) On Chest X-ray

Normal yes/no

If no Mild COAD yes/no

Moderate COAD yes/no

Fibrosis/consolidation yes/no

4. Blood Pressure (systolic):

5. Pulse Rate (per minute):

6. Glasgow coma scale:

7. Haemoglobin (g/100ml)

8. WBC count:

9. Serum Urea (mmol/L):

10. Serum Sodium (mmol/L):

11. Serum Potassium (mmol/L):

12. ECG:

Normal	yes/no
Atrial fibrillation (60-90/min)	yes/no
≥ 5 ectopics/min	yes/no
Q waves	yes/no
ST/T waves	yes/no

Any other abnormality-

Operative criteria:

Operative procedure done:

6. Operative severity: Minor / Moderate / Major / Major+
7. Multiple procedures:
8. Total blood loss:
9. Peritoneal soiling: None / Serous fluid /Blood / Pus / Bile/Faecal matter
10. Presence of malignancy: Yes/No

If death: Date and time:

Cause of death:

Physiological score:

Operative score:

POSSUM predicted mortality:

P – POSSUM predicted mortality:

MASTER CHART

S. No.	Name	Age/Sex	IP No.	C.H	R.S/CXR	P.R	B.P	GCS	Hb	TWBC	S. Na	S. K	B. Urea	ECG	Operative severity	No. of procedures	Blood loss	Peritoneal contents	Malignancy	Mode of surgery	Physiological score	Operative score	Mortality	POSSUM predicted mortality	P - POSSUM predicted mortality
1	Ramar	35/M	246	No	No	120	110/68	15/15	7.8	11200	136	4	44	N	M	1	120	Pus	No	E	24	20		0.33	0.14
2	Vellaisamy	30/M	1322	No	No	110	110/70	15/15	9.2	11200	138	3	57	N	M	1	150	Bile	No	E	27	20		0.42	0.22
3	Alagappan	55/M	1840	No	No	84	124/80	15/15	9	16700	128	3	18	N	M	1	350	Serous	No	E	24	14		0.12	0.04
4	Arokyam	38/M	1869	No	No	100	100/60	15/15	6.9	13400	143	4	10	N	M	1	900	Blood	No	E	22	26		0.49	0.21
5	Thangavel	63/M	1933	No	No	110	100/76	15/15	7.9	16400	133	3	37	N	M	1	500	Nil	No	E	26	15	yes	0.47	0.17
6	Murugesan	37/M	1945	No	No	106	110/70	15/15	11	5000	135	5	32	N	M	1	500	Serous	Yes	E	15	14		0.05	0.01
7	Varadarajan	32/M	1949	No	No	98	100/60	15/15	8.8	11400	136	4	42	N	M	1	70	Bile	No	E	23	19		0.27	0.1
8	Kalimuthu	35/M	2950	No	No	104	110/60	15/15	9.4	13200	132	4	48	N	M	1	70	Bile	No	E	25	19		0.32	0.15
9	Thiruvettai	50/M	2951	No	No	116	90/60	15/15	10.2	14200	142	3	30	N	M	1	70	Bile	No	E	23	19		0.27	0.1
10	Karuppiah	60/M	2973	No	No	120	90/70	15/15	8	11600	143	3	35	N	M	1	150	Bile	No	E	29	20		0.48	0.31
11	Karuppiah	55/M	3336	No	No	106	120/68	15/15	8.6	9800	139	4	43	N	M	1	150	Bile	No	E	29	20		0.38	0.19
12	Chinnasamy	61/M	3775	No	Yes	98	110/60	15/15	8.8	11200	136	4	48	N	M	1	100	Bile	No	E	22	19		0.24	0.09
13	Jaquiline	35/F	5002	No	No	116	90/60	15/15	9.8	16400	132	4	74	N	M	1	70	Faeces	No	E	30	19	yes	0.48	0.31
14	Maruthukalai	40/M	5107	No	No	88	110/70	15/15	9.4	12800	148	3	43	N	M	1	150	Bile	No	E	23	20		0.3	0.12
15	Virumandi	45/M	6611	No	No	98	92/70	15/15	9.7	13100	143	3	31	N	M	1	200	Nil	No	E	27	13		0.19	0.07
16	Rathinakumar	37/M	6630	No	No	108	120/90	15/15	10.1	12500	138	5	36	N	M	1	400	Nil	No	E	17	15		0.08	0.02
17	Soundarajan	36/M	10050	No	No	114	100/60	15/15	9.6	13200	139	4	63	N	M	1	70	Bile	No	E	27	19		0.38	0.2
18	Shanmugavel	46/M	12816	No	No	120	90/70	15/15	9	14100	138	3	13	N	M	1	70	Bile	No	E	30	19		0.48	0.31
19	Sasikala	24/F	15983	No	Yes	118	120/80	15/15	10.2	11600	132	4	37	N	M	1	600	Faeces	No	E	23	23		0.4	0.16
20	Pathimachina	43/M	17042	No	No	100	100/60	15/15	6.9	13400	143	4	10	N	M	1	900	Blood	No	E	22	26		0.49	0.21
21	Karthik	19/M	17709	No	No	136	90/70	15/15	11.2	17600	140	4	21	N	M	1	70	Bile	No	E	26	19		0.35	0.17
22	Nehru	31/M	19325	No	No	100	100/70	15/15	12.1	14300	136	4	17	N	M	1	70	Bile	No	E	16	19		0.13	0.03
23	Ramamoorthy	19/M	22424	No	No	120	110/70	15/15	10.2	18900	135	6	27	N	M	1	750	Bile	No	E	21	18		0.19	0.06

24	Kali	60/M	25269	No	No	92	120/80	15/15	9.1	11500	139	4	36	N	M	1	70	Bile	No	E	21	19		0.22	0.07
25	Manikandan	45/M	25312	Yes	No	98	90/60	15/15	9.2	18200	136	5	80	N	M	1	250	Bile	No	E	28	20	yes	0.45	0.26
26	Muniyandi	55/M	25398	No	No	110	90/60	15/15	9	11300	136	3	64	N	M	1	600	Blood	No	E	28	22	yes	0.52	0.31
27	Nallu	56/M	25766	No	Yes	98	92/70	15/15	9.7	13100	143	3	31	N	M	1	200	Nil	No	E	27	13		0.19	0.07
28	Maayi	35/M	26547	No	No	106	120/68	15/15	8.6	9800	130	3	43	N	M	1	150	Bile	No	E	29	20		0.48	0.29
29	Senbagaramesh	20/M	28695	No	No	94	110/80	15/15	11.6	12800	146	4	49	N	M	1	70	Bile	No	E	22	19		0.24	0.09
30	Rajesh	22/M	29422	No	No	120	110/70	15/15	16.8	18900	135	6	27	N	M	1	750	Bile	No	E	21	18		0.19	0.06
31	Eswaran	23/M	32438	No	No	92	110/70	15/15	6.1	13210	142	4	64	N	M	1	600	Blood	No	E	22	22		0.34	0.12
32	Veeranan	59/M	34340	No	No	98	90/60	15/15	9.1	12300	138	3	126	N	M	1	50	Bile	No	E	32	19	yes	0.54	0.39
33	Muthumari	34/M	34389	No	No	98	110/80	15/15	9.1	12600	137	3	56	N	M	1	70	Bile	No	E	25	19		0.32	0.15
34	Bhayammal	40/F	34434	No	No	98	110/70	15/15	8.7	11600	135	5	42	N	M	1	250	Blood	No	E	22	20		0.27	0.09
35	Duraipandi	34/M	36941	No	No	98	90/74	15/15	7.4	13800	138	2	62	N	M	1	600	Faeces	No	E	36	22		0.61	0.41
36	Veerapandi	22/M	41861	No	No	106	130/76	15/15	13	9500	141	3	32	N	M	1	550	Bile	No	E	16	22		0.19	0.04
37	Balakrishnan	44/M	43459	No	No	116	90/60	15/15	9.8	16400	132	4	76	N	M	1	70	Faeces	No	E	30	19		0.48	0.31
38	Kuppaiyan	55/M	46786	No	No	110	90/60	15/15	9	13200	140	4	55	N	M	1	70	Faeces	No	E	29	19		0.44	0.27
39	Kanthammal	50/F	48370	No	No	98	92/70	15/15	9.7	13100	143	3	31	N	M	1	200	Nil	No	E	27	13		0.19	0.07
40	Nambiraj	50/M	50091	No	No	94	100/70	15/15	7.6	11200	134	3	58	N	M	1	50	Bile	No	E	25	19		0.31	0.14
41	Mokkaiyan	30/M	50117	No	No	100	100/70	15/15	12.1	14300	136	4	17	N	M	1	70	Bile	No	E	16	19		0.13	0.03
42	Periyanan	49/M	51574	No	No	108	110/70	15/15	10.2	10500	134	4	36	N	M	1	200	Nil	No	E	15	13		0.04	0.1
43	Sekar	42/M	51982	Yes	No	124	100/60	15/15	8.2	12600	138	3	47	N	M	1	70	Faeces	No	E	30	19		0.48	0.31
44	Saraswathy	36/F	53113	No	No	106	130/76	15/15	13	9500	141	3	32	N	M	1	550	Bile	No	E	16	22		0.19	0.04
45	Ramzan	32/F	54761	No	No	98	90/74	15/15	7.4	13800	138	2	62	N	M	1	600	Faeces	No	E	36	22		0.61	0.41
46	Dhandapani	22/M	56255	No	No	112	100/70	15/15	8.8	14600	142	4	60	N	M	1	70	Faeces	No	E	27	19		0.38	0.2
47	Sevugan	60/M	58059	No	Yes	84	90/74	15/15	7.4	13800	138	2	62	N	M	1	600	Faeces	No	E	36	22	yes	0.62	0.43
48	Duraisamy	42/M	58068	No	No	112	100/70	15/15	9	12000	131	4	49	N	M	1	70	Nil	No	E	26	12		0.15	0.07
49	Ramar	45/M	59943	No	No	76	124/80	15/15	9	16700	128	3	18	N	M	1	350	Serous	No	E	24	14		0.12	0.04
50	Pandi	60/M	61205	No	No	110	100/60	15/15	8.8	8800	136	4	27	N	M	1	750	Blood	No	E	23	22	yes	0.37	0.15
51	Selvam	28/M	61841	No	No	100	110/70	15/15	10.3	11900	137	4	21	N	M	1	600	Pus	No	E	17	18		0.12	0.03
52	Karuppusamy	24/M	62795	No	No	132	110/80	15/15	8.9	9800	129	4	56	N	M	1	70	Serous	No	E	32	13		0.31	0.21
53	Sasikumar	35/M	62806	No	No	110	110/70	15/15	7.8	8900	138	4	46	N	M	1	70	Nil	No	E	23	12		0.11	0.04
54	Vignesh	19/M	63720	No	No	102	110/60	15/15	9.2	11200	135	4	43	N	M	1	150	Blood	No	E	25	20		0.36	0.17
55	Sakkare	59/F	67237	No	No	106	100/68	15/15	10.9	6000	129	5	17	N	M	1	350	Bile	No	E	18	20		0.18	0.05

56	Sundaram	57/M	67310	No	No	96	120/78	15/15	5.5	11200	135	4	17	N	M	1	150	Nil	Yes	E	18	16		0.1	0.02
57	Balakrishnan	65/M	67425	No	Yes	94	110/70	14/15	8.2	15600	139	5	124	N	M	1	1000	Blood	No	E	22	30		0.65	0.33
58	Ramachandran	41/M	70701	No	No	136	86/60	15/15	8.8	14300	132	3	124	N	M	1	150	Faeces	No	E	43	20	yes	0.85	0.86
59	Palanisamy	21/M	72129	No	No	98	110/70	15/15	8.2	6000	129	5	17	N	M	1	150	Bile	No	E	16	20		0.17	0.04
60	Muthu	58/M	73632	No	No	124	120/76	15/15	9.1	12400	130	5	76	N	M	1	600	Pus	No	E	31	22	Yes	0.62	0.39
61	Karuthapandian	40/M	75335	No	No	132	90/60	15/15	10	11300	132	4	47	N	M	1	70	Nil	No	E	28	12		0.19	0.1
62	Jothi	42/F	77379	No	No	130	96/70	15/15	9	12100	138	3	134	N	M	1	50	Bile	No	E	32	19		0.54	0.39
63	Raman	66/M	78558	No	No	128	90/60	15/15	7.6	4600	141	4	42	N	M	1	2000	Blood	No	E	32	27	yes	0.77	0.61
64	Arumugam	80/F	80009	No	Yes	128	90/60	15/15	9.6	13200	138	4	29	N	M	1	70	Serous	No	E	33	13	yes	0.34	0.24
65	Uma	19/F	80933	No	No	106	130/76	15/15	13	9500	141	3	32	N	M	1	550	Bile	No	E	16	22		0.19	0.04
66	Maheswaran	35/M	81484	No	No	110	80/60	15/15	11.2	8200	137	5	50	N	M	1	500	Bile	No	E	26	20		0.38	0.17
67	Murugan	43/M	81499	No	Yes	130	120/76	15/15	11.2	11700	131	5	15	N	M	1	600	Faeces	No	E	23	23		0.4	0.16
68	Chinnaiah	56/M	83136	No	No	98	110/60	15/15	8.8	11200	136	4	48	N	M	1	100	Bile	No	E	22	19		0.24	0.09
69	Prabhu	19/M	84845	No	No	136	100/60	15/15	11.2	14300	137	3	62	N	M	1	70	Nil	No	E	27	12		0.17	0.08
70	Santhiyagu	58/M	86134	No	No	110	100/60	15/15	9.9	12900	133	3	45	N	M	1	70	Nil	No	E	27	12	yes	0.17	0.08
71	Gurunathan	54/M	86430	No	No	108	110/70	15/15	10.2	10500	134	4	36	N	M	1	200	Nil	No	E	15	13		0.04	0.01
72	Kannusamy	68/M	87816	No	No	128	90/60	15/15	10.2	12000	134	3	70	N	M	1	70	Serous	No	E	31	13		0.28	0.18
73	Thirukannan	26/M	87830	No	No	110	90/60	15/15	9.2	12800	132	4	52	N	M	1	70	Nil	No	E	30	12		0.23	0.13
74	John Paulraj	58/M	89464	No	No	130	110/80	15/15	9.2	16200	139	3	132	N	M	1	200	Faeces	No	E	30	20		0.67	0.57
75	Saraswathy	56/F	92353	No	No	94	100/70	15/15	7.6	11200	134	3	58	N	M	1	50	Bile	No	E	25	19		0.31	0.14
76	Balu	40/M	99887	No	No	120	110/70	15/15	16.8	18900	135	6	27	N	M	1	750	Bile	No	E	21	18		0.19	0.06
77	Arokiaraj	20/M	101911	No	No	98	110/70	15/15	8.2	6000	129	5	17	N	M	1	150	Bile	No	E	16	20		0.17	0.04
78	Periya subbiah	65/M	101930	Yes	No	134	90/60	15/15	5.2	8300	138	6	54	N	M	1	1000	Blood	No	E	35	20		0.67	0.57
79	Laxmanan	22/M	103800	No	No	106	100/70	15/15	7.8	5400	137	4	30	N	M	1	900	Blood	No	E	23	22		0.37	0.15
80	Malayandi	24/M	103818	No	No	112	90/60	15/15	8	6700	140	4	19	N	M	1	1200	Blood	No	E	25	26		0.59	0.33

Key to Master chart:

C.H – Cardiac History

R.S/CXR – Respiratory system/chest Xray

P.R – Pulse rate

B.P – Blood pressure

GCS – Glasgow coma scale

Hb – Hemoglobin

TWBC – Total White blood cell count

S.Na – Serum Sodium

S.K – Serum sodium