# Comparison of Possum and P-Possum as Audit Tools in Patients Undergoing Emergency Laparotomy for Secondary Bacterial Peritonitis

## SUNIL KUMAR[1]

[1] Guru Teg Bahadur Hospital and University College of Medical Sciences

## Abstract

Background : Though POSSUM and P-POSSUM have been proposed as accurate tools of audit, our initial experience has not been encouraging. Therefore, a prospective study was conducted to find their accuracy for predicting outcome in peritonitis patients who underwent emergency laparotomy.Methods : 172 patients treated in single surgical unit over two years were included. Expected morbidity and mortality, computed by POSSUM and P-POSSUM equations using linear as well as exponential methods of analysis, were compared with observed outcome by observed: expected (O:E) ratios. X2-test was done to draw statistical significance; P<0.050 was taken as significant.Results : POSSUM significantly over-predicted mortality with linear as well as exponential methods with O:E ratios being 0.32 (X2=57.35, 1 d.f. P<0.001) and 0.25 (X2=111.26, 1 d.f. P<0.001), respectively. P-POSSUM also significantly over-predicted mortality by linear as well as exponential methods with O:E ratios being 0.55 (X2=11.37, 1 d.f. P<0.001) and 0.27 (X2=92.30, 1 d.f. P<0.001), respectively. POSSUM significantly over-predicted morbidity by linear and exponential analysis with O:E being 0.76 (X2=47.94, 1 d.f. P<0.001) and 0.81 (X2=23.27, 1 d.f. P<0.001), respectively.

*Index terms*— peritonitis, risk scoring, possum, p-possum, mortality, morbidity.

# 1 Introduction

n most hospitals across the world, and especially in third world countries, surgical audit is done using crude morbidity and mortality figures. Such audits that are not based on risk-adjusted analysis have gross limitations and do not allow true assessment of quality of care. Clearly, such an exercise lacks educational punch by virtue of ignoring the problems of case-mix. The Physiological and Operative Severity Score for enUmeration of Mortality and morbidity (POSSUM) takes care of problems of case-mix and has been suggested as powerful tool of audit of general surgery patients. 1 However, some studies suggested that conventional POSSUM may over-predict the mortality. [2][3][4] Author : Department of Surgery, Guru Teg Bahadur Hospital and University College of Medical Sciences. E-mail : drskg_15@sify.com This prompted us to conduct a pilot study involving about 75 patients with perforation peritonitis wherein accuracy of both, POSSUM and P-POSSUM for predicting the postoperative outcome, was analysed. We found that neither POSSUM nor P-POSSUM were accurately predicting the outcome (unpublished data), even when the recommended statistical methods were used for analysis. 6 Therefore, a larger study was undertaken to evaluate the value of POSSUM and P-POSSUM in predicting postoperative morbidity and mortality in patients with bowel perforation peritonitis in our set-up. Our working hypothesis was that neither equation, irrespective of the method of analysis, was accurate in predicting the postoperative outcome in our hands.

## 2 II.

## 3 Patients And Methods

One hundred and seventy two consecutive adult patients, undergoing emergency laparotomy for non-traumatic bowel perforation peritonitis in one of the surgical units at Guru Teg Bahadur Hospital and University College of Medical Sciences were studied prospectively over two years.

The physiological component of POSSUM data set was collected from parameters at admission before starting any kind of treatment intervention. The operative component was computed after laparotomy and revised if patient underwent re-laparotomy. Patients were treated as per their individual needs throughout their hospital stay. Previously given definitions 1 of postoperative complications were used while recording morbidity as yes or no. Mortality was also recorded as yes or no.

Patients were discharged from the hospital only after satisfactory recovery. All discharged patients were followed up in surgical outpatient department for a minimum of three months for treating early postoperative complaints (mostly wound related) and recording death within this period if any. Expected mortality was calculated from POSSUM 1 To counteract this problem the Portsmouth modification of POSSUM (P-POSSUM) was evolved, 4 and proved to be more accurate than POSSUM in predicting mortality. 3,4 One recent report from India found both of these to be reliable for predicting the outcome when correct methods of analysis were used. 5 POSSUM 4 equations using both linear as well as exponential methods as previously described. 6 Expected morbidity rates were calculated using POSSUM equation only as an equation of P-POSSUM for such purpose is still not available. The ratio of observed to predicted mortality and morbidity (O:E) were also calculated for each analysis separately. An O:E ratio above 1.0 indicates the risk is being underestimated while an O:E ratio under 1.0 indicates the risk is being over-estimated. 6 Finally, X 2 test was used to find any difference between predicted and observed rates of morbidity and mortality. P<0.050 was accepted as significant.

## 4 III.

## 5 Results

Indications for laparotomy are given in table 1. Mean (s.e.m.) age was 31.74 (2.42) and 138 (80%) were males. Mean (s.e.m.) length of hospital stay was 12.79 (0.98) days. One hundred and ninety four (194) episodes of postoperative complications were seen in 109 patients (table 2). Twenty-three patients died during the stay in the hospital. During follow-up in outpatient department there were no dropouts and deaths.

## 6 a) Mortality by POSSUM Equation

The results with linear and exponential methods of analysis are shown in table 3 and 4, respectively. Both methods significantly over-predicted the risk of death. The overall O:E ratio with linear analysis was 0.32 (X 2 =57.35, 1 d.f, P<0.001). The overall O:E ratio with exponential analysis was 0.25 (X 2 =111.26, 1 d.f, P<0.001).

## 7 b) Mortality by P-Possum Equation

The results of linear and exponential methods of analysis are shown in table 5 and 6, respectively. Both methods significantly over-predicted the risk of death. The overall O:E ration with linear analysis was 0.55 (X 2 =11.37, 1 d.f, P<0.001). The overall O:E ratio with exponential analysis was 0.27 (X 2 =92.30, 1 d.f, P<0.001).

## 8 c) Morbidity by linear and exponential analysis from POS-SUM equation

These results are shown in table 7 and 8, respectively. Liner method significantly over-estimated the risk of morbidity, overall O:E being 0.76 (X 2 =47.94, 1 d.f., P<0.001).

Similarly, exponential analysis significantly over-predicted the risk of morbidity, with O:E being 0.81 (X 2 =23.27, 1 d.f., P<0.001).

Table 9 gives the summary of above findings.

IV.

## 9 Discussion

A number of risk-adjusted scoring systems have been developed to suit audit of specialty-based practices such as cardiovascular 7,8 and gastrointestinal [9][10][11] diseases and ICU-care. 12 One of the most widely used scoring system is APACHE II. Though ideal for intensive care patients, its application has been validated in general surgical patients also. However, some of its well known limitations namely, need for repeated measure of variables for 24 h, too many variables, failure to take into account operative aspects, need for weighing tables for individual disease states and failure to predict morbidity, do not make it a popular choice with surgeons. Therefore, to audit the quality of care across the general surgical spectrum a simple scoring system, POSSUM, was developed in 1991. 1 Following its development a number of trials proved its validity in general surgery setup. 6,[13][14][15] However, some authors subsequently reported that it over-predicted the outcome. 4,16 Therefore,

P-POSSUM was evolved and a new equation was recommended. 4 This equation has also been modified since then for better prediction. 17 It was suggested that the over-estimation of the outcome by POSSUM is largely because of employment of linear method of analysis instead of exponential, much against the recommendations of Copeland et al. 6,18 This resulted in renewed interest in the use of POSSUM. A recent review heavily favors the use of POSSUM with proper analytical method but cautions against its use in patients with lowrisk of mortality. 19 Despite this general advocacy for use of POSSUM and P-POSSUM as the risk-scoring system for audit purpose sufficient evidence from tropical countries is lacking. This is desirable as the patients and treatment facilities in these countries tend to be quite different from those in developed countries. Patients here tend to present late, suffer from malnutrition and do not have access to world-class medical services. Our preliminary study involving 75 patients with perforation peritonitis suggested that neither POSSUM nor P-POSSUM were accurate in predicting the outcome (unpublished).

Subsequently, this larger study was undertaken. Predicted mortality rates were derived using equations of both scoring systems and linear as well as exponential methods of analysis. Since P-POSSUM equation has been not been proposed for deriving expected morbidity, it was used only for deriving expecting mortality. 4 Expected morbidity was derived using POSSUM equations with linear as well as exponential methods of analysis.

Our results show that POSSUM grossly overpredicted mortality by both linear as well as exponential method of analysis. P-POSSUM equitation also overpredicted mortality when analysed by either methods though linear analysis gave slightly better results than the other.

POSSUM equation also over-predicted morbidity when analysed by either method though exponential analysis gave slightly better results than the linear method.

It is difficult to find the exact cause(s) of overprediction in our study especially with availability of contrasting results of almost similar trial from another **??**————————————————————————————————————
——— government institution in Delhi. 5 Under-reporting of the in-hospital outcome and mortality beyond the period of the stay in hospital may be two important causes. However, we rule out under-reporting in our study as the consultant (SK) monitored the outcome on regular basis using strict suggested definitions. We also rule out any deaths beyond the period of stay in the hospital as we followed-up all discharged patients in outpatient department for three months postoperatively. This means that evidence is probably not sufficient to advocate the use of POSSUM or P-POSSUM in our kind of set-up. It is quite possible that a different regression equation is needed for predicting the outcome of the patients with life-threatening sepsis (such as secondary peritonitis) requiring emergency laparotomy. It is also possible that more variables are needed to generate a new 'usable' score as many a factors, known to have an impact on outcome, 4 have not been taken into account.

Overall, the issue of suitability of either POSSUM or P-POSSUM in our kind of set-up requires further evidence by way of larger studies involving similar patients. Thus, it can be summarized that both equations have not proved successful for accurate prediction of the outcome from perforation peritonitis in our hands. As suggested earlier, this may be because of many factors related to patients, treatment-practices or database. We feel that further studies are needed from third world countries addressing the suitability of either scoring system by standard analytical methods before employing the same freely for meaningful audit purposes. **??**—————————————————————————————————————————————————40-60 7 2 4 0.57 50-60 5 1 3 0.36 ————————
———————————————————————————————————————————

# 10  Global Journal of

Medical Research

[1]

---

Figure 1: 9 Volume

**1**

013
2
Year

Figure 2: Table 1 :

**2**

: Postoperative complications (seen in 109
patients; number of complications is larger than number
of patients because some had multiple complications)

| Complication | Number |
|---|---|
| Wound infection | 80 |
| Deep (intra-abdominal) infection | 27 |
| Anastomotic leak | 23 |
| Wound dehiscence | 21 |
| Chest infection | 18 |
| Septicemia | 09 |
| Others | 16 |

Figure 3: Table 2

**3**

| Mortality group (%) | Patients (n) | Actual deaths (n) | Predicted deaths (n) | O:E ratio |
|---|---|---|---|---|
| <10 | 4 | 0 | 0 | - |
| 10-20 | 30 | 1 | 5 | 0.20 |
| 20-30 | 35 | 2 | 9 | 0.22 |
| 30-40 | 23 | 1 | 8 | 0.13 |
| 40-50 | 21 | 6 | 9 | 0.67 |
| 50-60 | 20 | 2 | 11 | 0.18 |
| 60-70 | 17 | 3 | 11 | 0.27 |
| 70-80 | 8 | 2 | 6 | 0.33 |
| 80-90 | 6 | 2 | 5 | 0.40 |
| >90 | 8 | 4 | 8 | 0.50 |
| 0-100 | 172 | 23 | 72 | 0.32 |

Figure 4: Table 3 :

**4**

| Mortality group (%) | Patients (n) | Actual deaths (n) | Predicted deaths (n) | O:E ratio |
|---|---|---|---|---|
| 0-10 | 4 | 0 | 0 | 0.00 |
| 0-100 | 172 | 23 | 86 | 0.27 |

Figure 5: Table 4 :

**5**

| Mortality group (%) | Patients (n) | Actual deaths (n) | Predicted deaths (n) | O:E ratio |
|---|---|---|---|---|
| <10 | 60 | 2 | 3 | 0.67 |
| 10-20 | 35 | 4 | 5 | 0.80 |
| 20-30 | 29 | 5 | 7 | 0.71 |
| 30-40 | 14 | 1 | 5 | 0.20 |
| 40-50 | 11 | 2 | 5 | 0.40 |
| 50-60 | 6 | 3 | 3 | 1.00 |
| 60-70 | 3 | 0 | 2 | 0.00 |
| 70-80 | 4 | 1 | 3 | 0.33 |
| 80-90 | 7 | 3 | 6 | 0.50 |
| >90 | 3 | 2 | 3 | 0.67 |
| 0-100 | 172 | 23 | 42 | 0.55 |

Figure 6: Table 5 :

**6**

| Mortality group (%) | Patients (n) | Actual deaths (n) | Predicted deaths (n) | O:E ratio |
|---|---|---|---|---|
| 0-100 | 172 | 23 | 86 | 0.27 |
| 10-100 | 112 | 21 | 62 | 0.34 |
| 20-100 | 77 | 17 | 46 | 0.37 |
| 30-100 | 48 | 12 | 31 | 0.38 |
| 40-100 | 34 | 11 | 24 | 0.46 |
| 50-100 | 23 | 9 | 17 | 0.52 |
| 60-100 | 17 | 6 | 14 | 0.44 |
| 70-100 | 14 | 6 | 12 | 0.50 |
| 80-100 | 10 | 5 | 9 | 0.56 |
| 90-100 | 3 | 2 | 3 | 0.70 |
| 0-100 | 172 | 23 | 86 | 0.27 |

Figure 7: Table 6 :

**7**

| Morbidity group (%) | Patients (n) | Actual morbidity (n) | Predicted morbidity (n) | O:E ratio |
|---|---|---|---|---|
| <10 | 0 | 0 | 0 | - |
| 10-20 | 0 | 0 | 0 | - |
| 20-30 | 1 | 0 | 0 | 0.00 |
| 30-40 | 2 | 0 | 1 | 0.00 |
| 40-50 | 2 | 1 | 1 | 1.00 |
| 50-60 | 5 | 1 | 3 | 0.33 |
| 60-70 | 16 | 8 | 10 | 0.80 |
| 70-80 | 33 | 17 | 25 | 0.68 |
| 80-90 | 37 | 21 | 31 | 0.68 |
| >90 | 76 | 61 | 72 | 0.85 |
| 0-100 | 172 | 109 | 143 | 0.76 |

Figure 8: Table 7 :

**8**

| Morbidity group (%) | Patients (n) | Actual morbidity (n) | Predicted morbidity (n) | O:E ratio |
|---|---|---|---|---|
| 0-100 | 172 | 109 | 86 | 1.27 |
| 0-40 | 3 | 0 | 1 | 0.00 |
| - | | | | |

Figure 9: Table 8 :

**9**

$-$

Figure 10: Table 9 :

137 [ Br J Surg ()] , *Br J Surg* 2003. 90 p. .

138 [Linn ()] 'A protein energy malnutrition scale (PEMS)'. B S Linn . *Ann Surg* 1984. 200 p. .

139 [Whiteley et al. ()] 'An evaluation of POSSUM surgical scoring system'. M S Whiteley , D R Prytherch , B
140     Higgins , P C Weaver , W G Prout . *Br J Surg* 1996. 83 p. .

141 [Mcilroy and Copeland ()] 'An evaluation of POSSUM surgical scoring system'. B S Mcilroy , G P Copeland .
142     *Br J Surg* 1996. 83 p. .

143 [Midwinter and Ashley ()] 'An evaluation of the POSSUM surgical scoring system'. M J Midwinter , S Ashley .
144     *Br J Surg* 1996. 83 p. 1653. (letter)

145 [Knaus et al. ()] 'APACHE-II: a severity of disease classification system'. W A Knaus , E A Draper , D P Wagner
146     , J E Zimmerman . *Crit Care Med* 1985. 13 p. .

147 [Domaingue et al. ()] 'Cardiovascular risk factors in patients for vascular surgery'. C M Domaingue , M J Davis
148     , K D Cronin . *Anaesth Intensive Care* 1982. 10 p. .

149 [Cooperman et al. ()] 'Cardiovascular risk factors in patients with peripheral vascular disease'. M Cooperman ,
150     B Pflug , E W MartinJr , W E Evans . *Surgery* 1978. 84 p. 5059.

151 [Sagar et al. ()] 'Comparative audit of colorectal resection with POSSUM scoring system'. P M Sagar , M N
152     Hartley , B Maneey-Jones , P C Sedman , J May , J Macfie . *Br J Surg* 1994. 81 p. .

153 [Whiteley et al. ()] 'Comparative audit of colorectal resection with the POSSUM scoring system'. M S Whiteley
154     , D R Prytherch , B Higgins , P C Weaver , W G Prout . *Br J Surg* 1992. 82 p. .

155 [Wijesinghe et al. ()] 'Comparison of POSSUM and Portsmouth predictor equation for predicting death following
156     vascular surgery'. L D Wijesinghe , T Mahmood , Dja Scott , D C Berridge , P J Kent , R C Kester . *Br J*
157     *Surg* 1998. 85 p. .

158 [Greenburg et al. ()] 'Influence of age on mortality of colon surgery'. A G Greenburg , R P Saik , D Pridham .
159     *Am J Surg* 1985. 150 p. .

160 [Mohil et al. ()] 'POSSUM and P-POSSUM for riskadjusted audit of patients undergoing emergency laparotomy'.
161     R S Mohil , D Bhatnagar , L Bahadur , Rajneesh , D K Dev , M Magan . *Br J Surg* 2004. 91 p. .

162 [Prythererch et al. ()] 'POSSUM and Portsmouth POSSUM for predicting mortality'. D R Prythererch , M S
163     Whiteley , B Higgins , P C Weaver , W G Prout , S G Powell . *Br J Surg* 1998. 85 p. .

164 [Copeland et al. ()] 'POSSUM: a scoring system for surgical audit'. G P Copeland , D Jones , M Walters . *Br J*
165     *Surg* 1991. 78 p. .

166 [Copeland et al. ()] 'Risk adjusted analysis of surgeon performance: a 1-year study'. G P Copeland , P Sagar ,
167     J Brennan , G Roberts , J Ward , P Cornford . *Br J Surg* 1995. 82 p. .

168 [Altaca et al. ()] 'Risk factors in perforated peptic ulcer disease: comparison of a new score system with
169     Mannheim Peritonitis Index'. G Altaca , I Sayek , D Onat , M Cakmakci , S Kamiloglu . *Eur J Surg*
170     1992. 158 p. .

171 [Midwinter and Ashley ()] 'Risk stratification in vascular patients using modified POSSUM scoring system'. M
172     Midwinter , S Ashley . *Br J Surg* 1997. 84 p. A568.

173 [Neary et al.] *The Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity*,
174     W D Neary , B P Heather , J J Earnshaw . POSSUM.

175 [Copeland ()] 'The POSSUM system of surgical audit'. G P Copeland . *Arch Surg* 2002. 137 p. .

9