Wound infection

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WOUND INFECTION is a perennial problem which confronts surgeons in every part of the world. Recently, in the last ten years or so, a vast amount of literature, mainly from the Western countries, has been produced on this topic. No major study of wound infection had previously been carried out in West Malaysia. It was therefore decided to investigate 1,000 consecutive unselected cases with operative wounds in order to elucidate the factors involved in wound infection in our Malaysian patients. These patients were operated upon over a 10-month period from May 1st, 1971 to February 29th, 1972. They were admitted to the second General Surgical Unit at the General Hospital, Kuala Lumpur, West Malaysia. The study was conducted under the direct supervision of the author.

Materials and Methods

Definition of wound infection

The wound was adjudged to be infected when one or more of the following findings were recorded:

(1) Bacteria can be cultured from the wound in the presence of inflammation.
(2) Pus is present. Bacteria may or may not be culturable from the pus. Sterile pus may be present when antibiotics are used.
(3) The wound edges have broken apart. Here a distinction is made between the actual breaking apart of the wound edges due to infection and failure to bring the wound edges together in contact due to improper suturing.

Statistical methods

To test the equality of two proportions, P_1 and P_2, we set the null hypothesis H_0: $P_A = P_B$

against the alternative hypothesis H_1: $P_A > P_B$

The statistical test used is the standard Z — test with

$$Z = \frac{P_A - P_B}{\sqrt{Pq\left(\frac{1}{N_A} + \frac{1}{N_B}\right)}}$$

$$\text{where } P = 1 - q = \frac{f_A + f_B}{N_A + N_B}$$

— f_A being frequency of wound infection in sample A.

— f_B being frequency of wound infection in sample B.

— $N_A + N_B$ being total number of observations in samples A and B.

For a large number of observations, Z is the standardised normal variate and the compute values are compared with theoretical values, Z alpha, of Z at 100 alpha % levels of significance, that is, we are prepared to take a risk of 100 alpha or $P(Z > Z \text{ alpha})$ alpha.

For example, at 5% significant level, alpha = 0.05 and from the table of normal distribution, Z alpha = 1.6449. If the compute value of Z is less than Z alpha, there is no evidence to reject H_0 at 100 alpha % significant level. If the computed value of Z is greater than Z alpha, we say that there is evidence at 100 alpha% significant level that there is a significant difference between P_A and P_B, that is, $P_A > P_B$ or in other words, we reject H_0 in favour of H_1 at 100 alpha % significant level.

The operator

The second General Surgical Unit at the General Hospital, Kuala Lumpur, West Malaysia, consists of two specialist surgeons, one or more medical officers who are under training for a higher surgical qualification and three or more house doctors doing their pre-registration year. All these categories of medical staff operate on the patients within the limits of their capabilities. From Table 1, it can be seen that of the 421 cases which were operated upon by the surgeons, 30 (7.1%) developed wound infection. The medical officers operated upon 352 cases and 37 of these (10.5%) became infected. The house doctors performed 227 operations and from these, 32 wounds became infected, an infection rate of 14.1%. Of the 1,000 operations done, 99 wounds became infected, an overall infection rate of 9.9%. The infection rates of the surgeons and medical officers are statistically significantly different whilst there is no significant difference between the infection rates of the medical officers and house doctors.

Table 1 — The Operator

Operator	Number of Operations	Number of Wounds Infected	Percentage of Wounds Infected
Surgeons	421	30	7.1
Medical Officers	352	37	10.5
House Doctors	227	32	14.1
Total	1,000	99	9.9

Statistical analysis

$H_0: P_1 = P_2$, $H_1: P_1 < P_2$ — $Z = 1.6673$ — significant at 5% level.

$H_0: P_2 = P_3$, $H_1: P_2 < P_3$ — $Z = 1.3055$ — not significant at 5% level.

thus the 7.1% and 10.5% infection rates differ significantly from each other whilst the infection rates of 10.5% and 14.1% do not differ significantly.

Time of operation

The day was divided into three eight-hour sessions, 8.00 a.m., to 4.00 p.m., which are the normal working hours; and two other periods, 4.00 p.m., to 12 midnight, 12 midnight to 8.00 a.m. From Table 2, there were 667 cases operated upon in the 8.00 a.m., to 4.00 p.m. period, resulting in 42 infected wounds, an infection rate of 6.3%. The second highest wound infection rate was in the 4.00 p.m. to 12 midnight group where out of 250 cases operated upon, 28 (11.2%) developed infected wounds. Most wounds became infected when the operation was done between 12 midnight and 8.00 a.m., as 29 wounds (35%) developed infection amongst the 83 cases operated upon. The differences in the infection rates between these three groups of cases are statistically very significant.

Length of operative time

Table 3 shows that 126 operations lasted for 30 minutes or less and here nine wounds became infected, an infection rate of 7.1%. From the 298 operations which lasted between 30 and 60 minutes, there were 23 wound infections, an infection rate

Table 2 — Time of Day

Time of Day	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
8 a.m. to 4 p.m.	667	42	6.3
4 p.m. to 12 m.n.	250	28	11.2
12 m.n. to 8 a.m.	83	29	35
Total	1,000	99	9.9

Statistical analysis

a) $H_o: P_1 = P_2$) $Z = 2.5132$ very significant at 1% level.
$H_1: P_2 > P_1$)

b) $H_o: P_2 = P_3$) $Z = 4.983$ very significant at 1% level.
$H_1: P_3 > P_2$)

Thus the infection rates 6.3%, 11.2%, 35% are significantly very different from each other.

of 7.7%. There were 352 operations lasting 60 to 90 minutes and amongst these 28 wounds became infected, an infection rate of 8%. There were 35 wound infections for the 212 operations in the 90 to 120 minute group, the infection rate being 16.5%. The infection rate for operations lasting more than 120 minutes was 33.3% as there were four wound infections amongst the 12 cases. Statistically, there is no significant difference between the first three groups with infection rates of 7.1%, 7.7% and 8%. But the fourth and fifth groups of cases, with infection rates of 16.5% and 33.3%, differ significantly from the first three groups of cases. There is no statistical difference between the fourth and fifth group of cases.

Type of operation

There were three classes of operations according to whether bacteria were present in the tissues or not at the time of operation and, if present, whether or not the bacteria were actively multiplying, denoting an infective process, Table 4.

(1) **Clean operations**

No bacteria were present in the local tissues, for example a thyroidectomy.

(2) **Contaminated operations**

Bacteria were present in the local tissues as contaminants but were not actively multiplying, there being no infective process present, for example, partial gastrectomy.

(3) **Infected operations**

Bacteria were not only present in the tissues but were also actively multiplying, for example an inflamed appendix with abscess formation.

Table 4 shows that amongst the 316 clean operations done, 17 wounds (5.4%) became infected. For the 242 contaminated operations, there was an infection rate of 7.9% as 19 wounds became infected. The highest infection rate of 14.3% arose from the 442 infected cases which produced 63 wound infections. There is statistically no significant difference between the infection rates for clean and contaminated cases. There is a very significant difference between the infection rates of contaminated and infected cases.

Urgency of operation

These cases were grouped into emergency cases, which needed immediate operation, for example splenectomy, and elective cases, for example, hemithyroidectomy. (Table 5). There were 61 infected wounds amongst 338 emergency operations, an

Table 3 — Length of Operating Time

Time in Minutes	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
0 to 30	126	9	7.1
30 to 60	298	23	7.7
60 to 90	352	28	8
90 to 120	212	35	16.5
More than 120	12	4	33.3
Total	1,000	99	9.9

Statistical analysis

$H_o: P_1 = P_2$) $Z = 0.1962$ — not significant.
$H_1: P_2 > P_1$)

$H_o: P_2 = P_3$) $Z = 0.1118$ — not significant.
$H_1: P_3 > P_2$)

$H_o: P_3 = P$) $Z = 3.1448$ — not significant.
$H_1: P > P_3$)

$H_o: P = P$) $Z = 1.4957$ — not significant.
$H_1: P > P$)

Thus the infection rates of 7.1%, 7.7% and 8% do not differ significantly from one another. The rates of 16.5% and 33.3% do not differ significantly. The last two infection rates differ significantly from the first three infection rates.

Table 4 — Type of Operation

Type of Operation	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
Clean	316	17	5.4
Contaminated	242	19	7.9
Infected	442	63	14.3
Total	1,000	99	9.9

Statiscal analysis

$H_0: P_1 = P_2$, $P_2 > P_1$ $Z = 1.1916$ — not significant at 1% level.

$H_0: P_2 = P_3$, $P_3 > P_2$ $Z = 2.4732$ — very significant at 1% level.

Thus the infection rates of 5.4% and 7.9% do not differ significantly whilst the infection rates of 7.9% and 14.3% differ significantly.

Table 5 — Urgency of Operation

	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
Emergency cases	338	61	18
Elective cases	662	38	5.7
Total	1,000	99	9.9

Statiscal analysis

$H_0: P_1 = P_2$, $H_1: P_1 > P_2$ $Z = 6.2322$ — very significant at 1% level.

Thus the infection rates of 18% and 15.7% differ very significantly.

infection rate of 18%. Of the 662 elective operations, 38 developed wound infections, the infection rate being 5.7%. Thus urgent operations resulted in a much higher infection rate. The difference between the infection rates in the two groups of cases is statistically very significant.

Suture materials used

For suturing deeper structures other than skin either absorbable (catgut) or non-absorbable (nylon, silk, linen) sutures were used (Table 6). Eighty-eight wounds were infected amongst the 763 operations in which absorbable sutures were used, an infection rate of 11.5%. Of the 237 cases in which non-absorbable sutures were used, 11 wounds became infected, the infection rate being 4.6%. Thus wound infection was less frequent when non-absorbable sutures were used for the deeper structures. The difference in infection rates is very significant statistically. However, when wound infection did occur where non-absorbable sutures were used, the infection persisted for a much longer period with persistent discharging sinuses. Quite often these sinuses would only heal up when an underlying non-absorbable suture was first removed.

The use of drainage tubes

Table 7 classifies the cases according to whether or not drainage tubes were used. These were of rubber or plastic and were inserted into the depths of the wound itself or deeper, such as into the peritoneal cavity. Twenty-three wounds became infected amongst 151 cases where drainage was used, a wound infection rate of 15.2%. Only 76 wounds became infected in the 849 cases where drainage was not used, an infection rate of 9%. Therefore more wounds became infected if drainage was used. There is a very significant statistical difference between the two infection rates.

The order of the operation on the operating list

The first and last cases on the operating list for that particular day were analysed (Table 8). Amongst the 121 first cases, four wounds became infected, an infection rate of 3.3%. The 121 last cases produced 17 wound infections, an infection rate of 14%. Thus operations performed earlier were less liable to wound infection than those done later in the day when more cases had already passed through the operation theatre. The difference between the two wound infection rates is statistically very significant.

Antibiotics

Some patients had antibiotic therapy whilst others did not (Table 9). The antibiotics were either given locally to the wound or post-operatively systemically or a combination of the two. Local antibiotic consisted of Rikospray (bacitracin, polymyxin, neomycin mixture) manufactured by Riker Laboratories of Loughborough, England. There were 18 wound infections amongst the 135 cases where only topical antibiotics were used, an infection rate of 13.3%. Of the 221 cases which had combined topical and post-operative systemic antibiotic therapy, seven wounds became infected, an infection rate of 3.2%. Amongst the 268 cases where antibiotics were given, only systemically post-operatively ten wounds became infected, an infection rate of 3.7%.

In 376 cases, no antibiotics were given and here 64 wounds became infected, an infection rate of 17%. The infection rates of 13.3% when only local antibiotics are used and 3.2% when antibiotics are used locally and systemically post-operatively in combination, are very significantly different statistically. The 3.2% rate is not significantly different statistically when compared with the 3.7% infection rate when antibiotics are given only systemically post-operatively. The infection rate of 17%, when no antibiotics whatsoever are used, is statistically significantly different from the 3.7% infection rate.

Time of wound infection

Table 10 shows that out of the total of 99 infected wounds, 89 manifested whilst the patient was still in hospital. The infection most often appeared on the fourth or fifth post-operative day. There were ten cases of delayed wound infection which presented after the patient was discharged from hospital with an apparently healthy scar. Most of these delayed infections appeared within two months of the patients' discharge from hospital and the longest delay was four months.

Diathermy

In 651 cases, diathermy was used for coagulating and cutting. There were 76 wound infections here (Table 2), the infection rate being 11.7%. There were 23 wound infections amongst the 349 cases where diathermy was not used, an infection rate of 6.6%. The difference between the infection rates of the two groups of cases is statistically very significant.

Proteolytic enzyme

Chymoral, a trypsin-chymotrypsin mixture, (Armour Pharmaceutical Company, Eastbourne, England), was used in 398 cases, (Table 12). There arose 21 infected wounds from this group, a wound infection rate of 5.3%. There were 78 infected wounds amongst the 602 cases where chymoral was not used, an infection rate of 13%. There is a very significant difference statistically between the infection rates of the two groups of cases.

General health of the patient

There were two groups of patients, those in good general health and those whose general health was poor (Table 13). Patients in poor general health health suffered from various conditions such as dehydration, emaciation, obesity, old age, diabetes mellitus, previous steroid therapy. Seven hundred and thirty-three patients were in good general health and there were 44 wound infections here, an infection rate of 6%. Amongst the 267 patients in poor health, the infection rate was 20.6%, there being 55 wound infections. The difference in the infection rates of the two groups of cases is very significant statistically.

Bacterial spectrum

Table 14 shows that only 68 cases of wound infection yielded bacteria on culture. The commonest bacteria were the Coliform group of organisms, these being cultured in 31 instances. Coagulase positive staphylococcus aureus was obtained from 19 infected wounds, and were the next commonest bacteria. There were only two cases which yielded pseudomonas organisms on culture.

Table 6 — Type of Suture Material Used

Suture Material	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
Absorbable	763	88	11.5
Non-absorbable	237	11	4.6
Total	1,000	99	9.9

Statistical analysis

$$\begin{array}{l} H_0: P_1 = P_2 \\ H_1: P_1 > P_2 \end{array} \Bigg\} \quad Z = 3.363 \text{ — very significant at } 1\% \text{ level.}$$

Thus the infection rates of 11.5% and 4.6% differ very significantly.

Table 7 — Drainage Tube

	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
Drainage tubes used	151	23	15.2
No drainage	849	76	9
Total	1,000	99	9.9

Statistical analysis

$$\begin{array}{l} H_0: P_1 = P_2 \\ H_1: P_1 > P_2 \end{array} \Bigg\} \quad Z = 2.3908 \text{ — very significant at } 1\% \text{ level.}$$

Thus the infection rates of 15.2% and 4.6% differ very significantly.

Table 8 — Order of Case on Operation List

	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
First case	121	4	3.3
Last case	121	17	14
Total	1,000	99	9.9

Statistical analysis

$H_o: P_1 = P_2$) $Z = 2.9812$ — very significant
$H_1: P_1 < P_2$) at 1% level.

Thus the infection rates of 3.3% and 14% differ very significantly.

Discussion

Amongst the 1,000 cases, there were 99 infected wounds, a wound infection rate of 9.9%. The Second Surgical Unit, General Hospital, Kuala Lumpur, West Malaysia, from which the figures were produced is a general surgical unit and does not deal with ear, nose, throat, eye, neurological, orthopaedic and cardiac cases. A comprehensive survey in the United Kingdom was reported by the Public Health Laboratory Service (1960) and studied the sepsis rate in 12 British hospitals. The highest rate reported was 26.4% and the lowest 1.8%, the mean sepsis rate being 13.3%. The very low rate of 1.8% was recorded in an orthopaedic unit. From the Public Health Laboratory Service report, in the two hospitals in which most of the cases were recorded, 736 and 816 respectively, the sepsis rate was 13.9% and 13.0% respectively. The figure of 9.9% in the Malaysian patients therefore compares favourably. It is believed that good ward ventilation and lack of cold weather are important contributory factors in the Malaysian setting.

As expected, the two specialist surgeons in the unit had the least number of wound infections despite the fact that they operated on all the major cases such as stomach, oesophagus, gall-bladder, colon and thyroid. They had a 7.1% wound infection rate (Table 1). The medical officers, being less experienced, had a higher infection rate 10.5% which is statistically significantly different from the 7.1% rate. Most infected wounds (14.1%) arose in the cases operated upon by the house doctors as they lacked the degree of skill of their senior colleagues. Furthermore, they also operated on most of the emergency appendicectomies which included purulent, gangrenous and perforated appendices. However, the infection rates of the house doctors and medical officers are not significantly different statistically.

Table 9 — Antibiotics

	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
Local Antibiotics only	135	18	13.3
Local Antibiotics and post-operative systemic antibiotics	221	7	3.2
Post-operative systemic antibiotics only	268	10	3.7
No antibiotics	376	64	17
Total	1,000	99	9.9

Statistical analysis

$H_o: P_1 = P_2$) $Z = 3.6633$ — extremely significant at 1% level.
$H_1: P_1 > P_2$)

$H_o: P_2 = P_3$) $Z = 0.3432$ — not significant at 1% level.
$H_1: P_2 < P_3$)

$H_o: P_3 = P$) $Z = 5.2536$ — extremely significant at 1% level.
$H_1: P_3 < P$)

Thus the infection rates of 13.3% and 3.2% are very significantly different. The infection rates of 3.2% and 3.7% are not significantly different. The infection rates of 3.7% and 17% are very significantly different.

From Table 2, it is seen that as the operation day progresses, the wound infection rate rises. Table 3 shows that operations lasting up to 90 minutes all have the same degree of liability to wound infection. All operations lasting more than 90 minutes are equally liable to wound infection. Operations lasting less than 90 minutes are less liable to wound infection than those lasting more than 90 minutes. Smyth (1959) has shown previously that the incidence of wound infection rises proportionately with the duration of the operation.

For the operations which are last on the operating list, the wound infection rate is about four times that of infections done first on the operating list (Table 8). These figures in Tables 2, 3 and 8 support the fact that as more patients, staff and instruments pass through the operation theatre as the operation day moves on, the bacterial count of the air, instruments and other objects in the theatre rises (Douglas, 1963). A study by Bourdillon and Colebrook (1946) revealed that movements of staff, blankets and dressings resulted in a rise in the bacterial counts of air in the operating theatre. The staff themselves may be carriers of dangerous organisms even though they do not have overt sepsis and may cause wound infection (Shooter et al, 1957). There is much evidence that at least some wound infections are derived from the patient (Howe and Marston, 1962). Indeed, some surgeons do not operate on patients with skin infections, boils, sore throats or upper respiratory infections (Douglas, 1963).

As is expected, the highest wound infection rates follow upon operations which are infected (Table 4). The wounds in clean and contaminated cases are equally liable to infection whilst the infected operations are more likely to produce infected wounds. The study by the Public Health Laboratory Service (1960) accords with these findings.

The urgency of the operation has an important bearing on the incidence of wound infection. For the elective cases, the infection rate was only 5.7% whilst for the emergency cases, this is greatly increased to 18%. Wright et al (1971), in a survey of general surgical operations performed, quoted wound infection rates of 15% for elective operations and 30% for emergency operations.

When absorbable suture materials were used, the wound infection rate 11.5% was higher than when non-absorbable sutures were used, 4.6%. This is in agreement with other published series (Tagart, 1967). However, when infection did occur in those wounds where non-absorbable sutures were used, the infection often persisted until the suture was removed.

The wound infection rate was markedly increased when drainage tubes were used (Table 7). The tubes were inserted in the wound itself or into deeper areas such as the peritoneal cavity. This finding generally agrees with that of other workers (Lancet, 1970). The drain itself may conduct

Table 10 — Time of Wound Infection

	Number of Cases
In the ward	89
After discharge from hospital	10
Total	99

Table 11 — Diathermy

	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
Diathermy used	651	76	11.7
Diathermy not used	349	23	6.6
Total	1,000	99	9.9

Statistical analysis

$$\begin{matrix} H_0: & P_1 = P_2 \\ H_1: & P_1 > P_2 \end{matrix} \quad Z = 2.5743 \text{ — very significant at } 1\% \text{ level.}$$

Thus the infection rates of 11.7% and 6.6% are very significantly different.

infected material from deeper areas to the wound. Furthermore, bacteria from the skin of the patient may invade the depths of the wound through the drain (Douglas, 1963).

Antibiotics have been very effective in the prophylaxis of wound infection in this series (Table 9). This is in contradistinction to reported series from Western countries where with the continued use and abuse of antibiotics, resistant strains of bacteria have developed and the prophylactic value of antibiotics has declined. Some reports on large series of cases have shown no difference in wound infection in patients receiving systemic antibiotics compared with controls (Barnes et al, 1959; Fager, 1957; Hogman and Sahlin, 1957; Rocha, 1962; Sanchez-Ubeda et al, 1958; Thulbourne and Young, 1962).

Other reports have shown an actual rise in the wound sepsis rate in patients receiving systemic antibiotics (Fichtner, 1968; Myers, 1959; Tachdjian and Compere, 1957). Similarly, in contradistinction to the Malaysian patients, in this series, the use of topical antibiotics in Western patients does not appear to be so effective in preventing wound infections. Jackson et al (1971) in a series of 704 operation wounds used the antibiotic Rikospray in the wound just before the skin closure. The results showed that the spray did not prevent most wound infections.

Table 9 also shows that when systemic antibiotics are used post-operatively, the additional use of local antibiotics to the wound during the operation did not significantly reduce the infection rate. The use of post-operative systemic antibiotics, in addition to locally applied antibiotics significantly reduces the infection rate.

It is important to note, as shown in Table 10, that although the wound appears normal and there is no pain, fever or other signs of infection, the wound may become infected later at some time after discharge of the patient from hospital. The outpatient follow-up of all operated cases is therefore made even more important.

In this series of 1,000 patients, there is a marked increase of wound infection when diathermy is used (Table 11). The wound infection rate is almost doubled when diathermy is used. This accords with the findings of Madden et al (1970) who noted the increased susceptibility of wounds to infection when diathermy was used and found that this was due to coagulation necrosis of tissue.

The use of proteolytic enzymes promotes dissolution, absorption and removal of exudate and blood clot in the area of the wound. Thus a good culture medium for bacterial growth is removed and it is to be expected that incidence of wound infection would therefore be reduced. This is confirmed in the present series, there being a 13% wound infection rate when the enzyme was not used whilst the rate fell to 5.3% when the enzyme was used (Table 12).

The general health of the patient is an important factor (Table 13). There were more than three times the number of wound infections in patients in poor general health (20.6%) compared to those in good health (6%).

In this series of 1,000 cases, 99 wounds became infected but only 68 of these grew bacteria on culture (Table 14). In most of the infected wounds where no bacteria were culturable, antibiotics had been used. By far the commonest infecting bacteria were the Coliform organisms, followed in second place by staphylococcus aureus. This is in contrast to Western figures where staphylococcus aureus accounted for more than 60% of the bacteria infecting wounds (Public Health Laboratory Service Survey, 1960).

Summary

A thorough survey of 1,000 unselected consecutive wounds was made in the second General Surgical Unit, Kuala Lumpur, West Malaysia. The findings are generally in agreement with published reports from the Western countries. The important exception in this Malaysian series is that, at least for the time being, antibiotics are extremely effective in the prophylaxis of wound infection. We are now at the stage when antibiotics were first used in Western countries and it is to be hoped that indiscriminate and excessive use of antibiotics as in the West will not lead to the stage where they are not so effective in preventing wound infection.

It is felt that other factors may contribute to the fairly low rate of wound infection in these Malaysian patients. Thus the warm windy Malaysian climate where there is no winter provides good ventilation in the wards. The Malaysian patients are also, on the whole, very much less obese than Western patients. Again, due to shortage of hospital beds, our patients have a very short pre-operative stay in hospital. This factor may contribute to an appreciable fall in the wound infection rate (Wright, 1971).

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Table 12 — Proteolytic Enzyme

	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
Chymoral need	398	21	5.3
Chymoral not used	602	78	13
Total	1,000	99	9.9

Statistical analysis

$H_0: P_1 = P_2$)
$H_1: P_1 < P_2$) $Z = 3.9926$ — extremely significant at 0.1% level.

Thus the infection rates of 5.3% and 13% are extremely sifinificantly different.

Table 13 — General Health of Patient

	Number of Cases	Number of Wounds Infected	Percentage of Wounds Infected
Good general health	733	44	6
Poor general health	267	55	20.6
Total	1,000	99	9.9

Statistical analysis

$H_0: P_1 = P_2$)
$H_1: P_1 < P_2$) $Z = 6.7327$ — extremely significant at 0.1% level.

Thus the infection rates of 6% and 20.6% are extremely significantly different.

Table 14 — Bacterial Spectrum

Bacteria	Number of Cases
Coliform group	31
Staph Aureus (Coagulase +ve)	19
Staph (Coagulase —ve)	11
Proteus group	3
Strept Faecalis	2
Pseudomonas group	2
Total	68

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