SURGICAL WOUND INFECTIONS

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Graduation with Honors to the Department of Biology,
Carroll College, Helena, Montana

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SIGNATURE PAGE

THIS THESIS FOR HONORS RECOGNITION HAS BEEN APPROVED FOR THE DEPARTMENT OF BIOLOGY.

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Abstract

In this study we looked at the wound infection rate in surgeries at Hospital A for the months of August, September, October, and November, 1989. For these four months the hospital acquired an overall infection rate of 7.34 % for the 463 surgeries performed during this time period. A databank was established to acquire as much information as possible concerning the patients, the surgeons, and the surgery that was to be performed. Checks for postoperative infections in surgical wounds were made at three, seven and twenty eight days. Wounds were judged as infected if purulent drainage collected from the wound was found to have microorganisms in it. Many other aspects of wound infection rates were looked at, including whether or not the patients were diabetics or nondiabetics, whether or not patients were given antibiotics or steroids before surgery, and infections by wound class. Anesthesia risk category was also considered. It was found that the higher the patient's anesthesia risk category, the more vulnerable the patient was to infection in a surgical wound. By stratification of different aspects of patients and their specific surgeries, more and more information can be gained with the result that wound infection rates from surgical procedures can be minimized.

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Introduction

This project was an attempt to look into many of the various aspects behind surgical wound infection rates in Hospital A. Along with Dr. John Pullman, Mary Ann Lynch, and K.C. Irish, I worked on this project in an effort to lower the overall infection rate and to find some aspect in surgical procedures that will help Hospital A minimize their infection rate. Reducing the infection rate or attempting to reduce this rate can only serve to help all people involved (including doctors and patients) as these infections cause pain, discomfort, high costs, and even death.

In looking at the history of surgical wound infections, we come to see that medicine has advanced incredibly in the past 100-200 years. Igmal Semmelweis, in March 1847, discovered the importance of prophylactic surgical antisepsis (washing and scrubbing the hands before surgery) when investigating the death of a friend who had died from puerperal fever. By surgeons "scrubbing the hands in warm soap and water with a nail brush, followed by a similar scrub in chlorine" puerperal sepsis is now almost non-existent[9].

Placing antiseptics into open wounds has been practiced for centuries, as cited in the parable of the Good Samaritan (Luke 10:34). In 1867 Joseph Lister led the way to great surgical advances by instilling various concentrations of carbolic acid into the open wounds of compound fractures, a practice that extended later to other wounds and eventually to elective surgery[9].

Despite these advances surgery and surgeons continued to have problems. Misery and mortality from "hospital gangrene" continued well into the 1890's[9]. Von Nussbaum, in 1874, said that wound infections "growing like a wild beast, slew or permanently crippled 80 out of every hundred" of his

surgical patients. During the Franco Russian War of 1870, Von Nussbaum had a 100% mortality rate in 34 consecutive knee amputations[8]. During this war, on the French side 13,173 amputations of all kinds, including digits, were performed, resulting in 10,006 deaths[8].

By 1900, many changes had occurred in surgical techniques. Kocher of Bern, Switzerland, introduced precise bloodless surgical techniques, and in effect he reduced infection rate in clean cases to 2.3 percent[9]. At this time in the United States a man name Halsted became a champion of asepsis, and thus minimized his infection rate in surgery, although no percentage was published concerning his infection rate[9]. However, even with the advanced aseptic techniques and the knowledge of microorganisms and antimicrobial agents, surgical wound infections still have a high rate of incidence. In 1963 approximately 25,000,000 people were admitted to hospitals in the U.S., and more than 1,000,000 developed post operative or hospital-acquired infections[9]. In 1976, more than 2,100,000 people developed hospital acquired infections, with 150,000 deaths resulting[9]. Based on the incidence in five American university centers, the overall wound infection rate was 7.4 percent[1]. In a study by the National Nosocomial Infection Committee in 1979, surgical wounds were reported as accounting for 52-98 infections per 10,000 hospital discharges[21]. These infections account for 18-27% of all nosocomial infections, with the most common pathogens being Staphylococcus aureus and Escherichia coli[21].

Obviously, surgical wound infections are still common today. Disability, delayed healing, deformity, or even death can result from these infections. Also the quality of life, both physical and psychological, has often been affected or permanently altered by surgical wound infections.

When discussing wounds subject to infection, we must include surgical, traumatic, or physiologic wounds. Surgical wounds include, of course, all wounds incurred during the course of surgery. Traumatic wounds include deep cuts, compound fractures, frostbite necrosis, and thermal burns. Physiologic wounds include, for example, the endometrial surface after the separation of the placenta and the umbilical stump[24].

What are the sources of infection in these types of wounds? Contributing factors to infection include:

1) the patient's own normal flora
2) infectious material from carriers or other infected individuals that may reach the wounds (i.e., through the air or on the hands of attendants)
3) pathogenic organisms from the inanimate environment that can contaminate the wound through soil, clothing, and other foreign material[24].

With the large numbers of microorganisms that can cause infection, along with the numerous sources of infection, prevention of infection is certainly a continuing challenge for modern surgery.

In surgical and traumatic wounds, there are four categories used in classifying wounds: (1) clean, (2) clean-contaminated, (3) contaminated, or (4) dirty[3]. Clean wounds include those in which neither the gastrointestinal nor the respiratory tract is entered, no apparent

inflammation is encountered, and no break in aseptic technique occurs. If no acute inflammation is present, procedures such as cholecystectomy, incidental appendectomy, hysterectomy are included in this category[9]. These wounds also do not traverse infected tissues or extend into sites with normal flora[24].

Clean-contaminated wounds include clean operations that enter the gastrointestinal tract or respiratory tract, but no significant spillage occurs in the operation[9]. These are surgical wounds that extend into sites with a normal flora (e.g., small intestine) without known contamination[24].

Contaminated wounds include operations in which acute inflammation (without pus formation) is encountered, or in which gross spillage from a hollow viscus occurs[9]. Operations in which a major break in aseptic technique occurs or fresh surgical and traumatic wounds with a major risk of contamination (such as incisions entering nonpurulent infected tissues) are included in this category[24].

Dirty (or infected) wounds include old, infected traumatic wounds, wounds substantially contaminated with foreign material and operations in which pus was encountered[9]. This category also includes wounds contaminated with spillage from perforated viscera[24].

With broad categories like these, there will be differences from person to person regarding the classification of a particular wound. Nevertheless, these four categories provide a helpful guide in classifying types of wounds encountered in surgery.

When is a wound considered infected? Discharges from a wound may be reported sterile when cultured, even from a wound that is definitely infected. On the other hand, bacteria can be recovered from a wound that is healing

without infection. Classification based solely on clinical judgment is biased and subjective, so investigators have established a set of uniform clinical criteria to study infection rates[6]. Surgical wounds are considered uninfected if they heal in a certain amount of time without discharge. They are definitely infected if pus is discharged, even if organisms are not cultured from the purulent material. Wounds are possibly infected if the wounds are inflamed without discharge and if the wound drains culture-positive serous fluid. Wounds that have stitches in them are excluded from definite or possible infection if (a) inflammation and discharge are minimal and confined to points of suture penetration or (b) the incision heals within a certain amount of time without drainage.[10] In this study, wounds were classified as infected if purulent drainage from a wound was found to have microorganisms in it when examined by the lab.

Using these guidelines, investigators have conducted a number of studies on surgical wound infection rates. In a comprehensive study done by Swartz at the University of Virginia, in a period of one year (1968-69) 1,115 surgeries were carefully observed[2]. Forty eight of those patients were found to have surgical wound infections (4.3 percent), four of whom died. In his study, Swartz looked at the cost for those with surgical wound infections. He divided cost into three categories: direct, indirect, and intangible. Direct costs included hospital room, physicians' charges, and infection control costs. Indirect costs were calculated on the basis of salary lost because of prolonged illness or death. Intangible costs, for which no price tag could be assessed, referred to the cost of pain, discomfort, isolation, and various incalculable expenses the patient otherwise would not have had had the patient not acquired the infection[2].

For the 48 infected patients in the Swartz study, the direct cost was $114,576. Of the 1,115 surgical patients, the mean length of stay for the noninfected population was 11.61 days, while for the patients with wound infections the mean stay was 35.48 days. An estimated sum of all the indirect and direct costs ranged from $6,700 to $9,500 for each patient that had a wound infection[2]. In another study, the estimated overall cost for wound infections in the United States was approximately $9.8 billion, for an approximate 1,400,000 wound infections (7.4 percent of all operations)[8]. With the cost of hospital care now skyrocketing, these figures represent an escalating contributing factor in medical costs now and into the future.

In 1967, a group of physicians undertook a ten year project to look at all surgical wounds at Foothills Hospital at the University of Calgary in Calgary, Alberta. These physicians had four goals: (a) to obtain an accurate monthly infection figure to be used as the guide to the efficient functioning of the operating rooms, surgical wards, and the surgeons; (b) to obtain a 10-year bank of wound statistics with which future variations could be compared; (c) to determine the factors that influence the infection rate; (d) to reduce the infection rate[8].

In 1977, the physicians' ten year goal was achieved, with the accumulation of 62,339 wounds which now can be used to show trends and changes in etiologic factors. A full time surgical surveillance nurse personally observed all wounds throughout each patient's stay, in an effort to reduce bias. Telephone follow up on each case continued for a total of 28 days. Oral, rectal, and vaginal operations, burns, and circumcisions were excluded from the study. All the information was stored in a computer, and details of the operation and the patients' progress were also recorded[8].

Some very interesting results came out of this study. The overall infection rate of the 62,939 wounds was 4.7 percent, with clean wounds accounting for 1.5 percent of the overall infections, clean-contaminated accounting for 7.7 percent, contaminated accounting for 15.2 percent, and dirty accounting for 40.0 percent of all the wound infections. Also, ten percent of the infected wounds became evident only after the patient had left the hospital, which shows the importance of the 28 day telephone follow up[8].

What did the investigators make of all these data? The overall infection rate in a hospital can vary significantly, depending on the type of surgery done. If many clean cases, such as hernias, are done, the infection rate will be much lower than if many bowel operations are done. Therefore, infection rates will also differ from department to department. However, the clean wound infection rate gives a valuable reflection of the quality of surgical care in a hospital. In these wounds endogenous bacterial contamination is low, and therefore other procedures including hand scrub and skin preparation can be accurately assessed. Also, this allows comparisons between different surgical departments and different surgeons.

Using these same wound criteria, Altemeier's General Surgical Service at Cincinnati General Hospital achieved a clean wound infection rate of 1.2 percent[12]. In the Foothills study, it was not unusual for a surgeon to obtain a clean wound infection rate of less than one percent. A clean wound infection rate of less than one percent is excellent, 1 to 2 percent is acceptable, and more than 2 percent is a cause for concern, according to the Foothills study[8].

All the surgeons in the Foothills study did the same operations in the same surgical wards and operating rooms, so the clean wound infection rate

gave an interesting statistic where differences in infection rate could only be ascribed to differences in surgical technique. Many of the surgeons in the Foothills study began to take pride in their clean wound infection rate, which was discussed in monthly staff meetings. The study generated a friendly competitive atmosphere, and happily reduced the infection rate in the Foothills hospital.

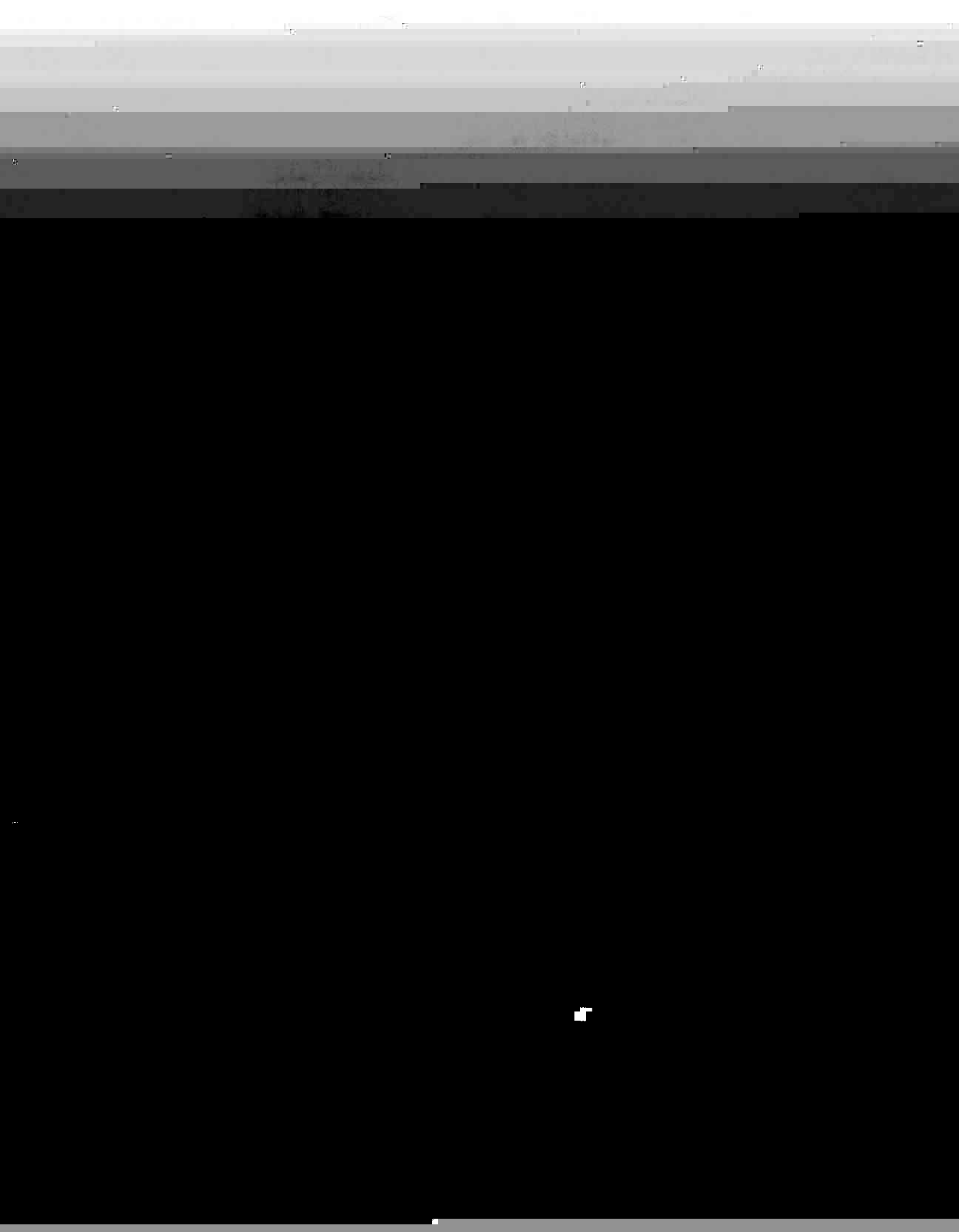
In order to have an infection, there must be a contaminated wound, and therefore many aspects in surgical technique have come under attack. First, investigators began to look at the surgeon's hands. Surgeons began to wear surgical gloves, initially because some patients were sensitive to the skin antiseptics that surgeons apply to their hands[13]. These gloves must cover the fingers and hands, and they also must extend over the wristlets of the gown. If a hole should develop in the glove, the surgeon's hands must be scrubbed and disinfected in order to minimize the chance of infection[26]. In fact, in a study done by Devenish and Miles in 1939, it was found that 30 percent of the gloves used in operations develop holes in them[13]. Using a complicated electronic circuit, the investigators in the Foothills study found that 11.6 percent of the gloves used in operations developed perforations, but none of these breaks led to infections, probably due to the surgeons' hands having been disinfected prior to surgery.

Thus, decontamination of the surgeon's hands appears to be more important than gloves[16]. Most surgeons now either use a povidone-iodine surgical scrub or a hexachlorophene-scrub. In comparing the two, the povidone-iodine scrub (Betadine) has a greater immediate impact than the hexachlorophene does (Phisohex), but the povidone-iodine also has no prolonged further action inside the glove. Hexachlorophene's disadvantage is that is

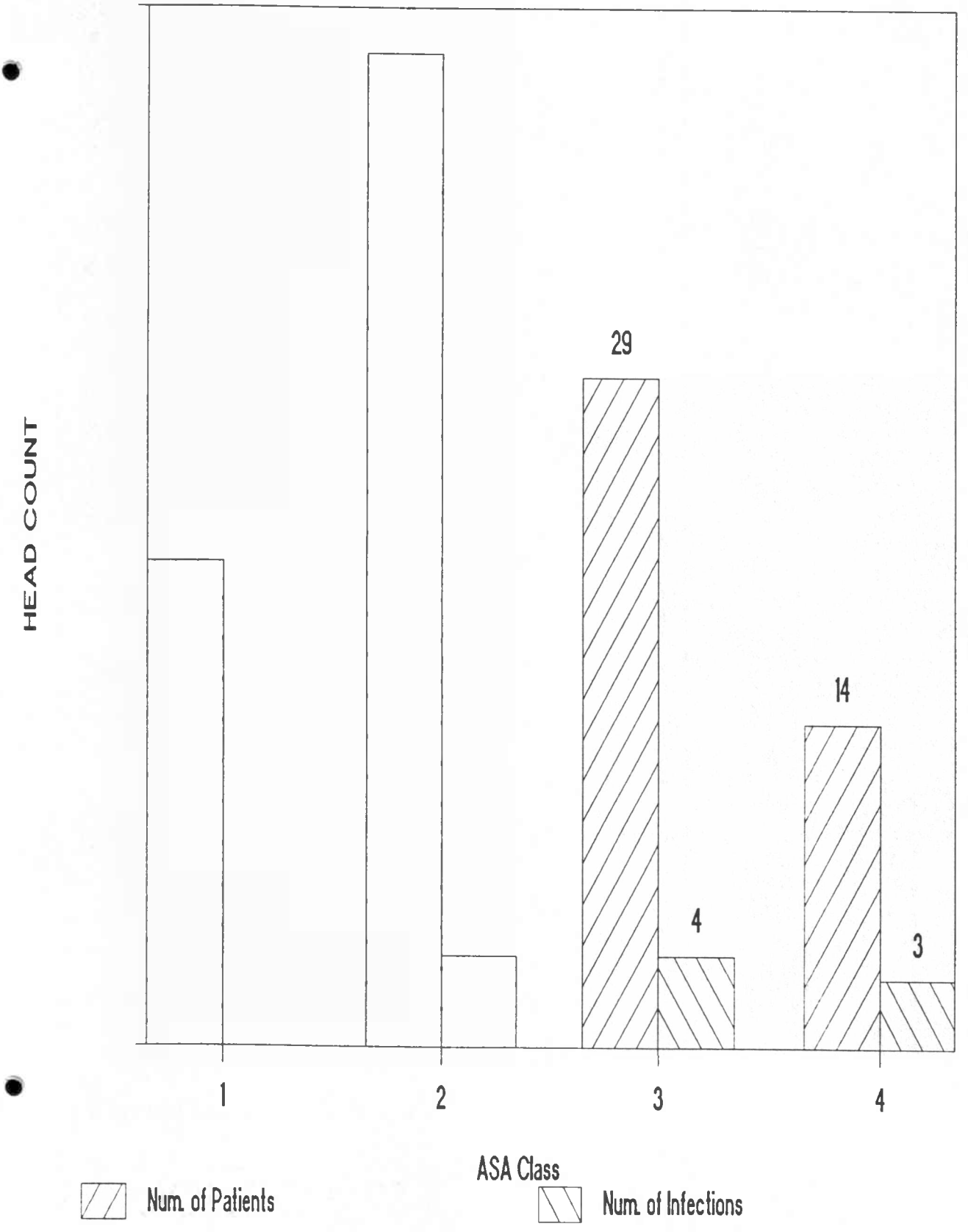
very slow acting. Some surgeons now use a chlorhexidine scrub (Hibitane) which combines the action of the povidone-iodine and the hexachlorophene, and is effective against both gram-negative and gram-positive bacteria[8,16].

Some emphasis has been placed on the length of scrub time for a surgeon. In a 1969 study, Dinsen found no difference a the end of 2 hour operations between surgeons who scrubbed for 5 minutes versus 10 minutes, with respect to bacterial counts on the surgeons' hands[15]. Originally, surgeons called for 10 minute scrubs, but the time wasted seems large so most surgeons now scrub for 3 to 5 minutes, with no significant infection rate attributed to the shorter scrub time[17].

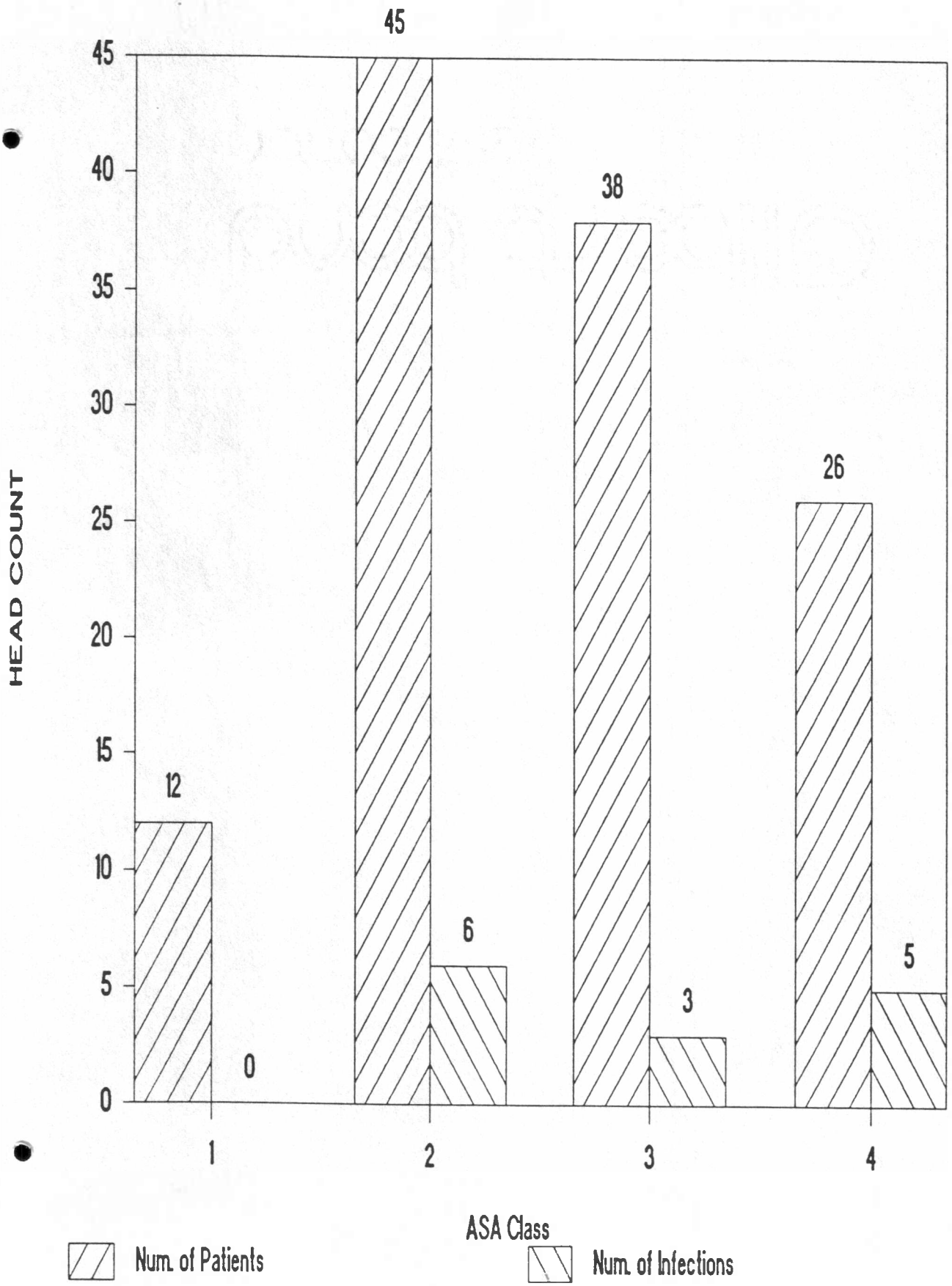
In the preparation of the patient's skin, many different factors have been looked at in an effort to reduce the infection rate. A preparation shower with hexachlorophene has been shown to reduce infections[6]. An interesting aspect, concerning shaving the patient before an operation, is that patients shaved had an infection rate of 5.6 percent, while patients who weren't shaved had an infection rate of .6 percent[4]. In this study, Seropian and Reynolds have stressed the importance of shaving immediately before surgery (not allowing bacteria to grow in razor nicks) versus shaving the night before an operation[23]. With respect to preparation of the operation area on the patients's skin, sterile gloves and sterile supplies should be used during this procedure. In a study done by Lowbury, Lilly, and Bull, it has been found that 1 percent iodine to 70 percent alcohol and 5 percent chlorhexidine in 70 percent alcohol are the most effective skin antiseptics[17]. With these investigators' findings, most hospitals now apply these two skin antiseptics with friction for 2 minutes as a preoperative skin preparation, thereby reducing the infection rate[8]. Appropriate draping is



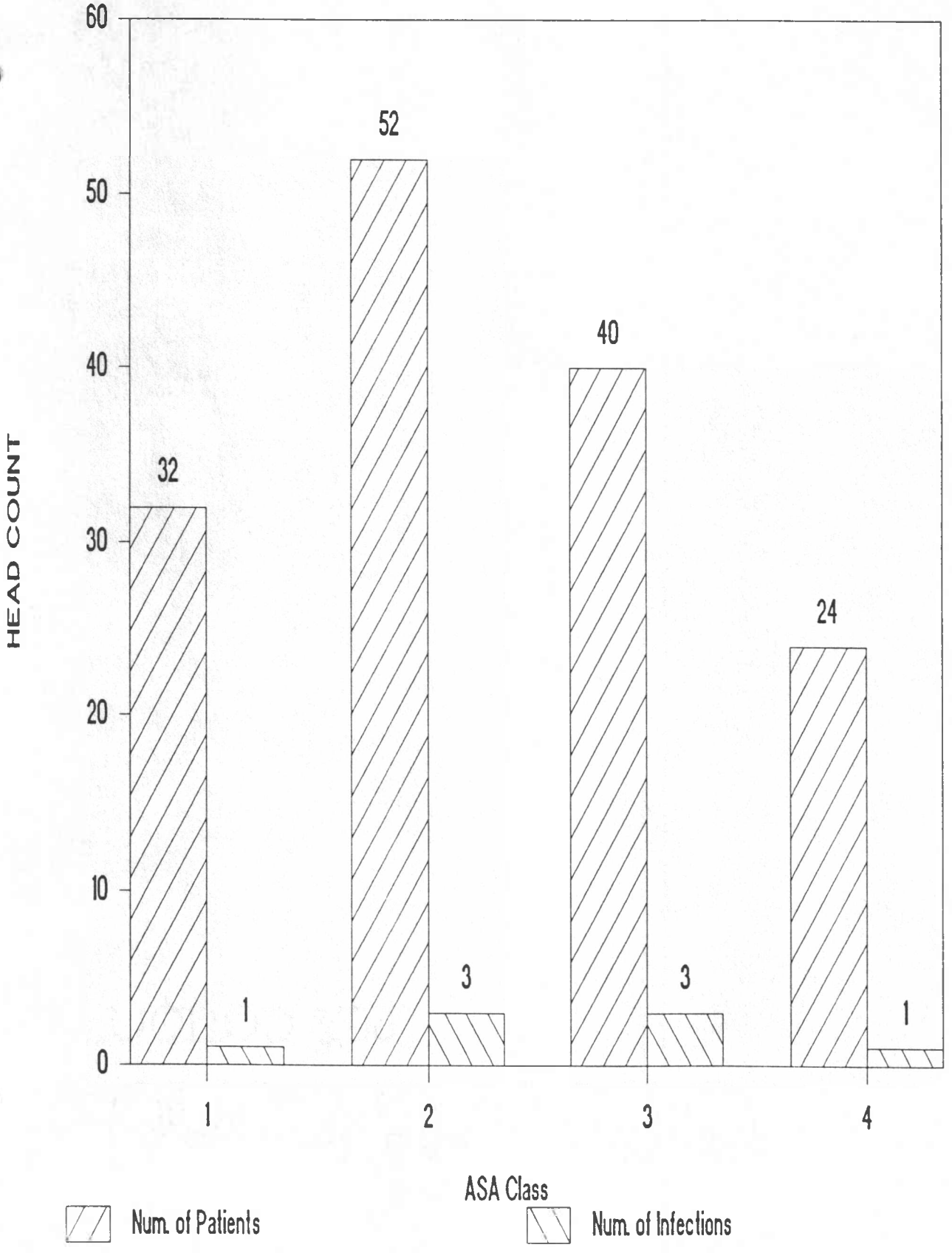
AUGUST 1989


HEAD COUNT
29
4
14
3
1
2
3
4
ASA Class
Num. of Patients
Num. of Infections

SEPTEMBER 1989



OCTOBER 1989



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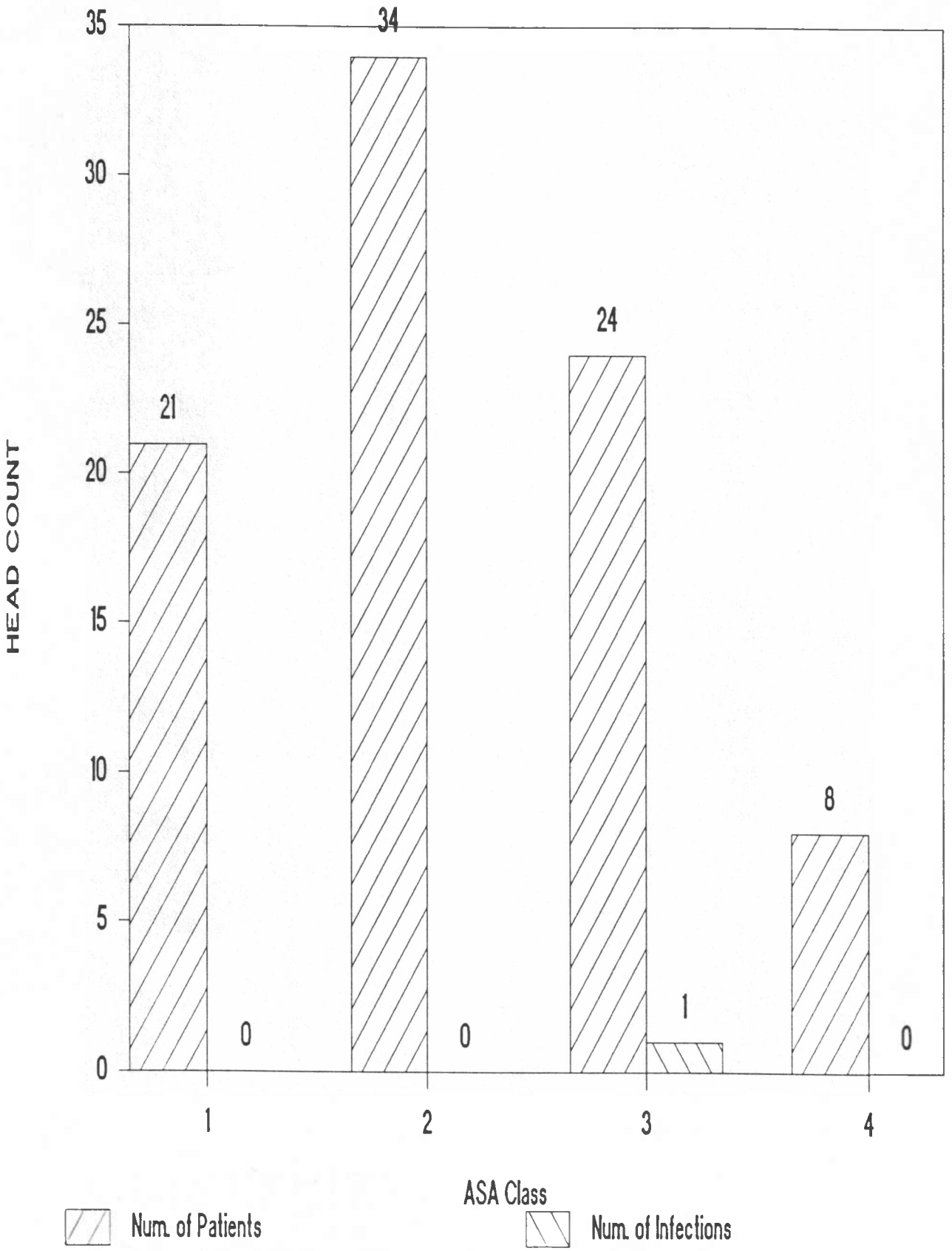
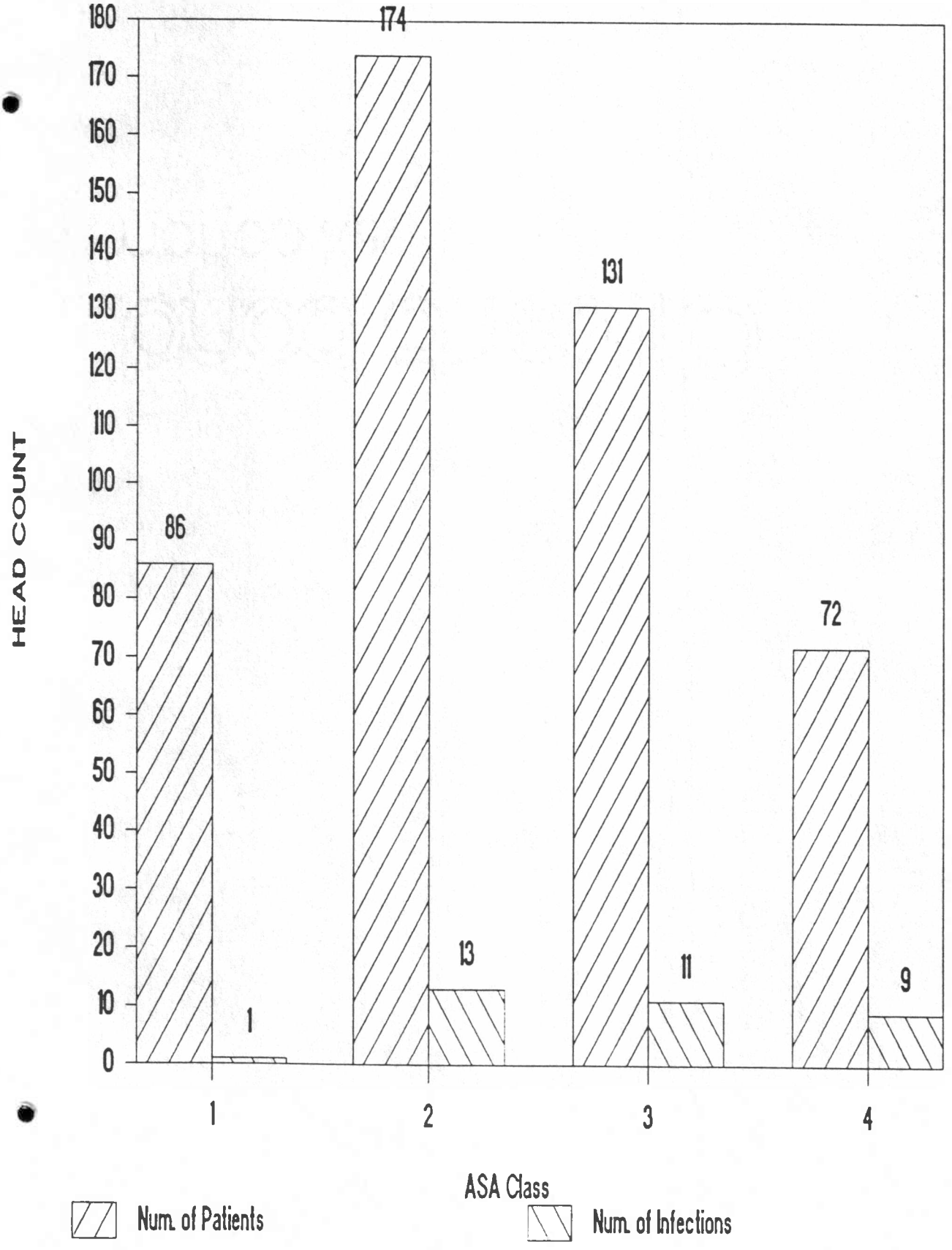


TOTALS


HEAD COUNT
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
86
1
174
13
131
11
72
9
1
2
3
4
ASA Class
Num. of Patients
Num. of Infections

August - Surgeon's Report

Surgeon Coded	# of Surgeries	# of infections	%
1	21	2	9.52%
2	2	0	0.00%
3	1	0	0.00%
4	2	0	0.00%
5	8	0	0.00%
6	2	1	50.00%
7	14	4	28.57%
9	4	1	25.00%
10	8	0	0.00%
11	1	0	0.00%
12	2	0	0.00%
13	4	0	0.00%
15	20	2	10.00%
16	6	0	0.00%
18	8	1	12.50%
20	2	0	0.00%
21	2	0	0.00%
	107	11	10.28%

Infections According to Wound Class

Surgeon Coded	Wound Class	# of Surgeries	# of Infections	%
1	2	8	1	12.50%
1	4	2	1	50.00%
6	2	1	1	100.00%
7	1	5	3	60.00%
7	3	2	1	50.00%
9	3	3	1	33.33%
15	2	10	2	20.00%
18	1	6	1	16.67%

Infections According to Anesthesia Class

Surgeon Coded	ASA Class	# of Surgeries	# of Infections	%
1	2	6	1	16.67%
1	4	6	1	16.67%
6	2	2	1	50.00%
7	2	3	1	33.33%
7	3	1	1	100.00%
7	4	6	2	33.33%
9	3	2	1	50.00%
15	2	9	1	11.11%
15	3	7	1	14.29%
18	3	4	1	25.00%

(Note - All other surgeries and surgeons had a rate of 0.00% in these categories. Only infections were considered.)

September - Surgeon's Report

Surgeon Coded	# of Surgeries	# of infections	%
1	16	0	0.00%
2	4	0	0.00%
3	6	1	16.67%
4	1	0	0.00%
5	5	0	0.00%
7	36	11	30.56%
8	1	0	0.00%
9	1	0	0.00%
10	8	0	0.00%
11	6	0	0.00%
12	3	0	0.00%
13	1	0	0.00%
15	11	1	9.09%
16	3	0	0.00%
18	2	1	50.00%
20	9	0	0.00%
21	8	0	0.00%
	121	14	11.57%

Infections According to Wound Class

Surgeon Coded	Wound Class	# of Surgeries	# of Infections	%
3	2	2	1	50.00%
7	1	10	3	30.00%
7	2	9	1	11.11%
7	3	7	4	57.14%
7	4	10	3	30.00%
15	2	8	1	12.50%
18	2	2	1	50.00%

Infections According to Anesthesia Class

Surgeon Coded	ASA Class	# of Surgeries	# of Infections	%
3	2	3	1	33.33%
7	2	12	5	41.67%
7	3	10	2	20.00%
7	4	14	4	28.57%
15	3	5	1	20.00%
18	4	1	1	100.00%

(Note - All other surgeries and surgeons had a rate of 0.00% in these categories. Only infections were considered.)

October - Surgeon's Report

Surgeon Coded	# of Surgeries	# of infections	%
1	16	2	12.50%
2	2	0	0.00%
3	6	0	0.00%
5	1	0	0.00%
6	1	0	0.00%
7	24	3	12.50%
9	6	0	0.00%
10	15	1	6.67%
11	3	0	0.00%
13	3	1	33.33%
15	38	0	0.00%
16	1	0	0.00%
18	12	0	0.00%
20	17	1	5.88%
21	3	0	0.00%
	148	8	5.41%

Infections According to Wound Class

Surgeon Coded	Wound Class	# of Surgeries	# of Infections	%
1	2	11	1	9.09%
1	4	2	1	50.00%
7	2	4	2	50.00%
7	4	1	1	100.00%
10	1	8	1	12.50%
13	2	3	1	33.33%
20	1	13	1	7.69%

Infections According to Anesthesia Class

Surgeon Coded	ASA Class	# of Surgeries	# of Infections	%
1	3	8	1	12.50%
1	4	4	1	25.00%
7	2	12	2	16.67%
7	3	3	1	33.33%
10	1	9	1	11.11%
13	3	2	1	50.00%
20	2	8	1	12.50%

(Note - All other surgeries and surgeons had a rate of 0.00% in these categories. Only infections were considered.)

November - Surgeon's Report

Surgeon Coded	# of Surgeries	# of infections	%
1	16	0	0.00%
2	3	0	0.00%
3	4	0	0.00%
5	3	0	0.00%
7	9	1	11.11%
9	6	0	0.00%
10	5	0	0.00%
11	10	0	0.00%
13	2	0	0.00%
15	11	0	0.00%
18	8	0	0.00%
20	7	0	0.00%
21	3	0	0.00%
	87	1	1.15%

Infections According to Wound Class

Surgeon Coded	Wound Class	# of Surgeries	# of Infections	%
7	2	8	1	12.50%

Infections According to Anesthesia Class

Surgeon Coded	ASA Class	# of Surgeries	# of Infections	%
7	3	3	1	33.33%

(Note - All other surgeries and surgeons had a rate of 0.00% in these categories. Only infections were considered.)

Totals - Surgeon's Report

Surgeon Coded	# of Surgeries	# of infections	%
1	69	4	5.80%
2	11	0	0.00%
3	17	1	5.88%
4	3	0	0.00%
5	17	0	0.00%
6	3	1	33.33%
7	83	19	22.89%
8	1	0	0.00%
9	17	1	5.88%
10	36	1	2.78%
11	20	0	0.00%
12	5	0	0.00%
13	7	1	14.29%
15	80	3	3.75%
16	10	0	0.00%
18	30	2	6.67%
20	35	1	2.86%
21	19	0	0.00%
	463	34	7.34%

Infections According to Wound Class

Surgeon Coded	Wound Class	# of Surgeries	# of Infections	%
1	2	19	2	10.53%
1	4	4	2	50.00%
3	2	2	1	50.00%
6	2	1	1	100.00%
7	1	15	6	40.00%
7	2	21	4	19.05%
7	3	9	5	55.56%
7	4	11	4	36.36%
9	3	3	1	33.33%
10	1	8	1	12.50%
13	2	3	1	33.33%
15	2	18	3	16.67%
18	1	6	1	16.67%
18	2	2	1	50.00%
20	1	13	1	7.69%

Totals - Surgeon's Report (Cont.)

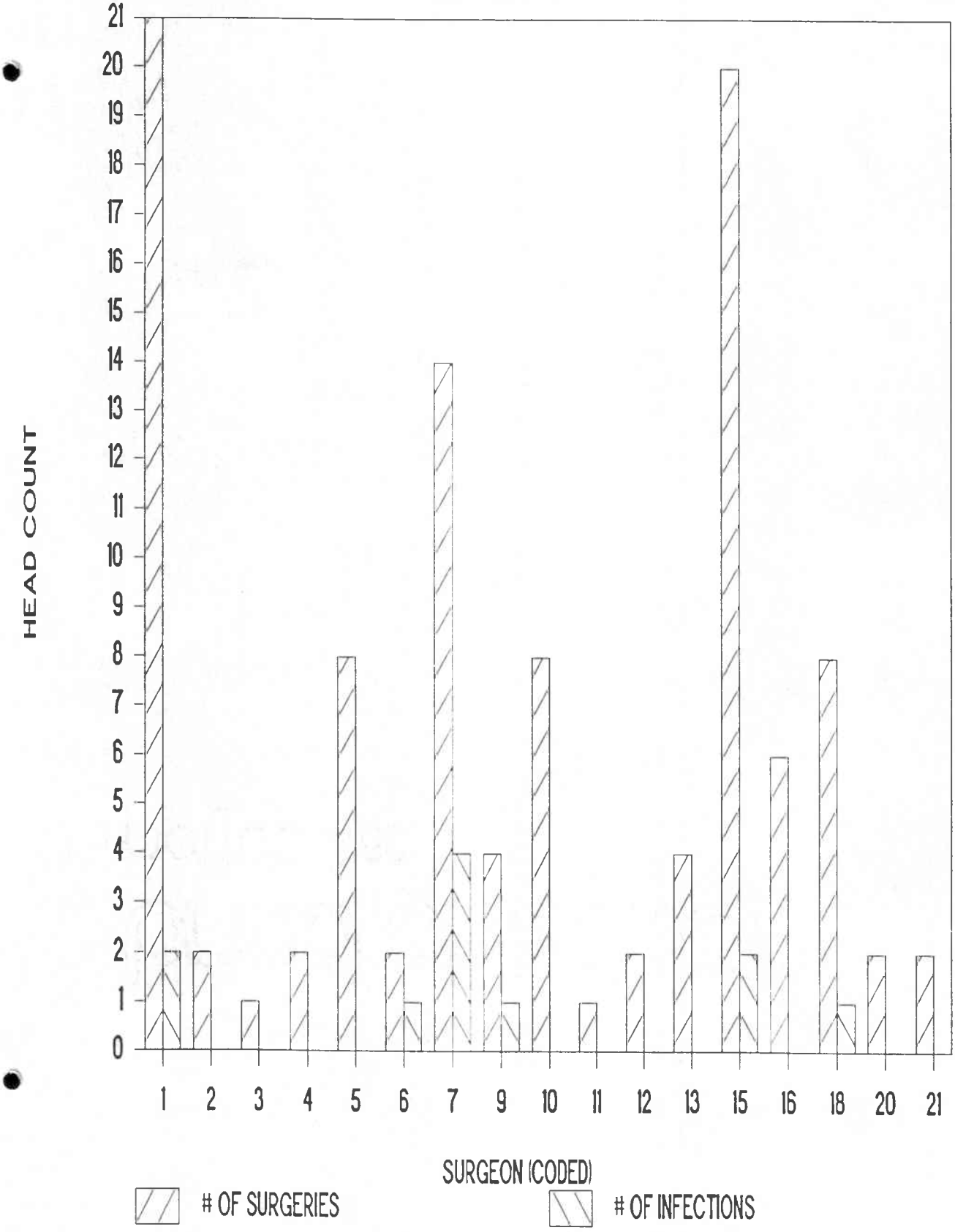
Infections According to Anesthesia Class

Surgeon Coded	ASA Class	# of Surgeries	# of Infections	%
1	2	6	1	16.67%
1	3	8	1	12.50%
1	4	10	2	20.00%
3	2	3	1	33.33%
6	2	2	1	50.00%
7	2	27	8	29.63%
7	3	17	5	29.41%
7	4	20	6	30.00%
0	3	2	1	50.00%
10	1	9	1	11.11%
13	3	2	1	50.00%
15	2	9	1	11.11%
15	3	12	2	16.67%
18	3	4	1	25.00%
18	4	1	1	100.00%
20	2	8	1	12.50%

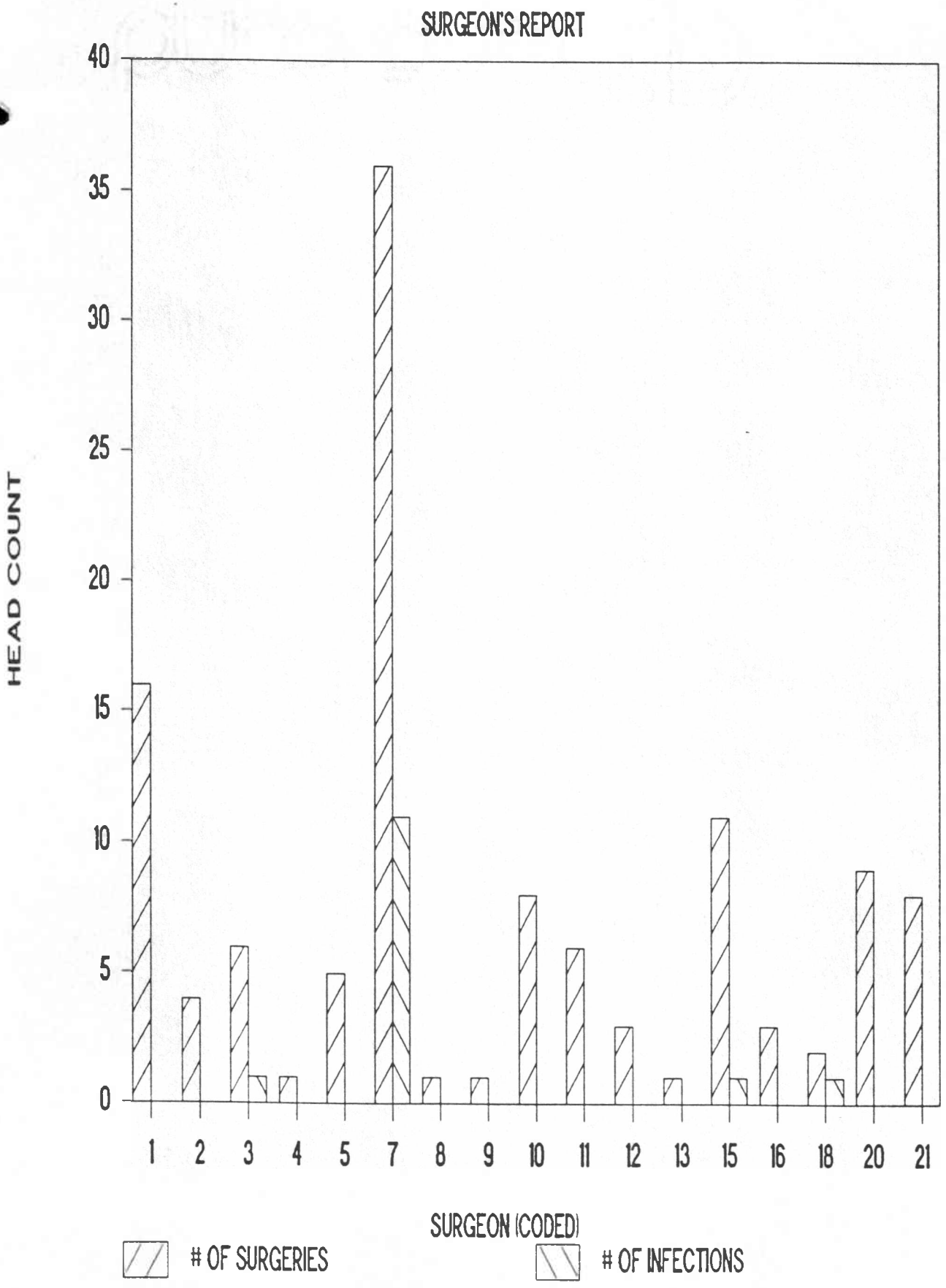
(Note - All other surgeries and surgeons had a rate of 0.00% in these categories. Only infections were considered.)

AUGUST

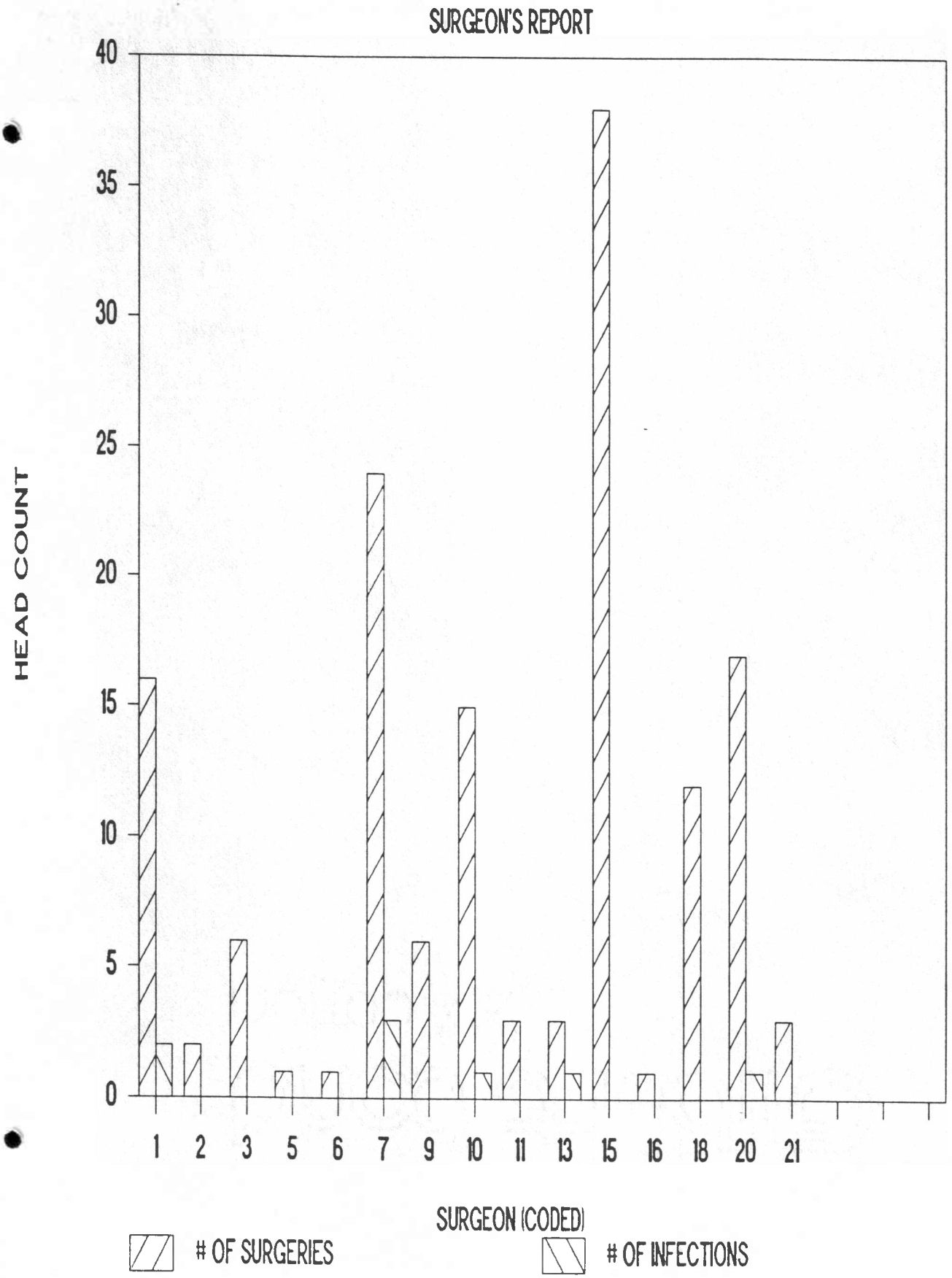
SURGEON'S REPORT



SEPTEMBER


SURGEON'S REPORT
HEAD COUNT
40
35
30
25
20
15
10
5
0
1
2
3
4
5
7
8
9
10
11
12
13
15
16
18
20
21
SURGEON (CODED)
OF SURGERIES
OF INFECTIONS

OCTOBER


SURGEON'S REPORT
HEAD COUNT
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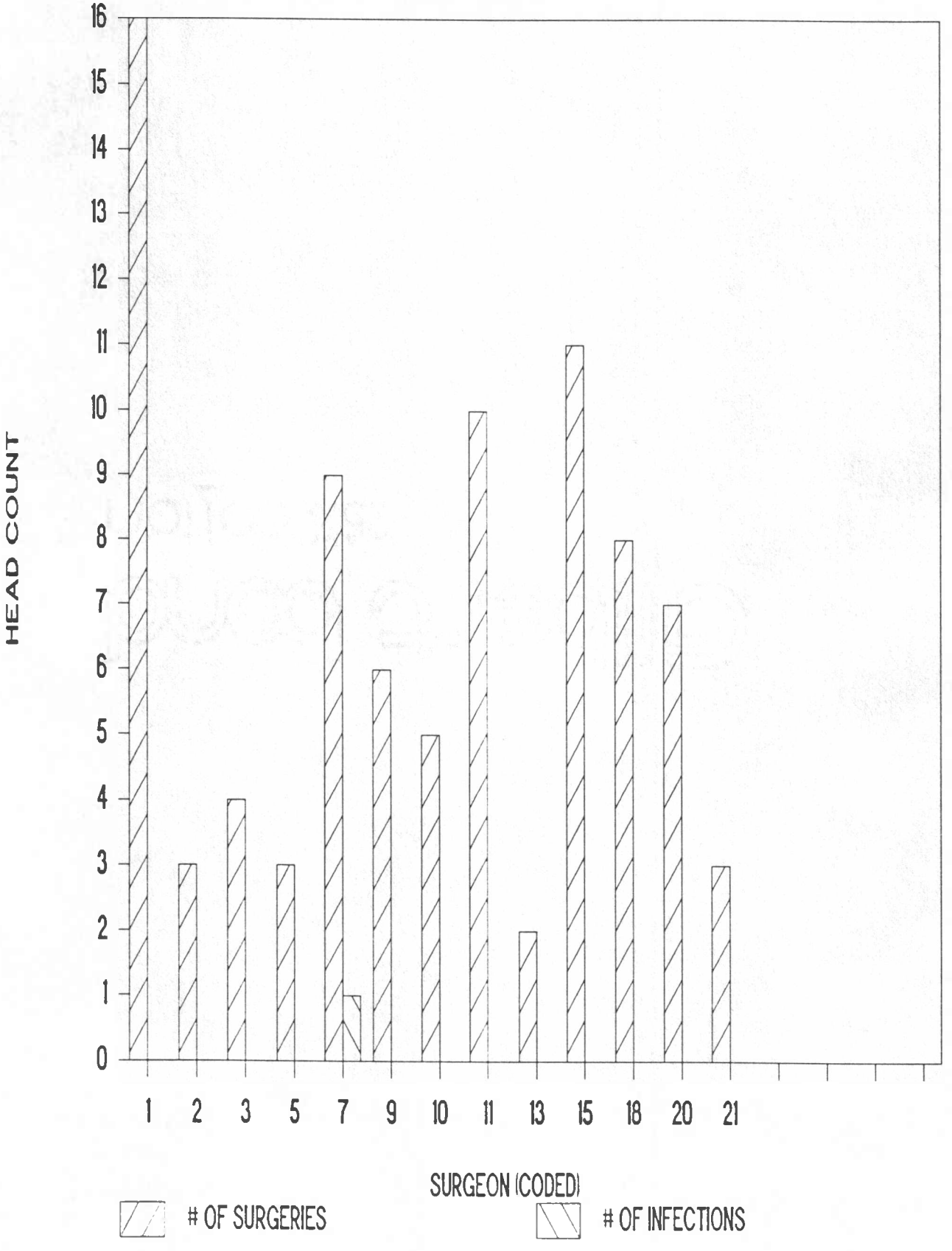
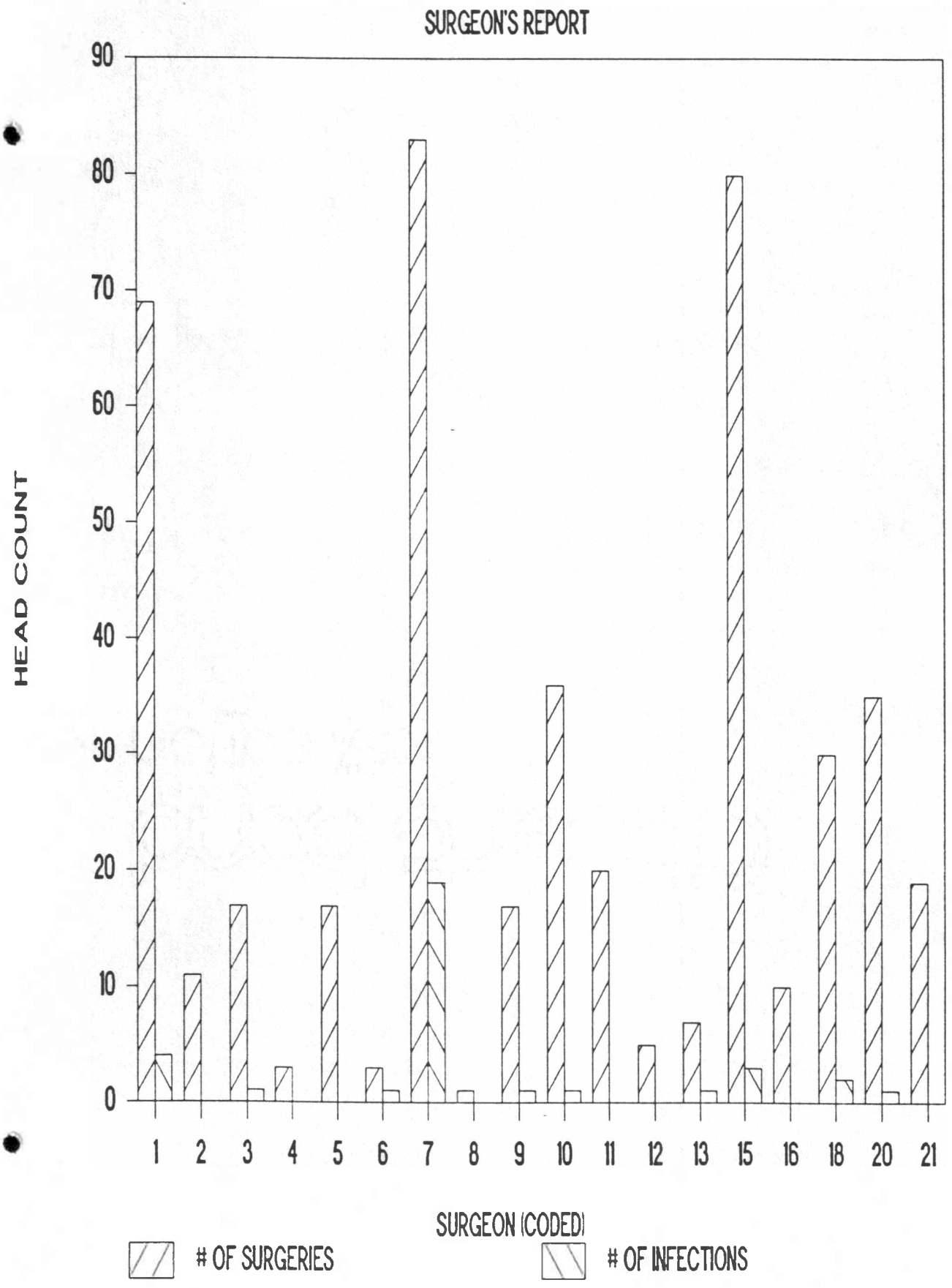
35
30
25
20
15
10
5
0
1
2
3
5
6
7
9
10
11
13
15
16
18
20
21
SURGEON (CODED)
OF SURGERIES
OF INFECTIONS

NOVEMBER

SURGEON'S REPORT



TOTALS


SURGEON'S REPORT
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6
7
8
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11
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21
SURGEON (CODED)
OF SURGERIES
OF INFECTIONS

Discussion and Conclusions

Many interesting results have come out of this study. First I will take a look at the overall wound infection rate, which turned out to be 7.34%. This compares favorably with some earlier mentioned studies which had rates of 7.4% and 4.7%[1,8]. Also, these earlier studies did not look at all the surgeries in their respective hospitals. So, while the rate at Hospital A may seem higher than earlier studies, I feel our 7.34% rate is more reflective of the overall infection rate, in that it includes every surgery.

Another interesting fact is that the overall rates in August and September (10.28% and 11.57%) were much higher than the rates in October and November (5.41% and 1.15%). Perhaps once the surgeons started seeing their infection rates in the first two months, they may have been more careful about certain procedures in the latter two months, thereby reducing their individual rates. The publishing of these rates may also have created a friendly competitive atmosphere, which very well could have reduced the rate. Of course, other factors may have contributed to the lower rates in the latter months and only through further study could these aspects be assessed.

An anomaly of this study shows the infection rate in diabetics (6.45%) to be lower than the infection rate in non-diabetic patients (7.41%). This does not agree with other wound infection studies, which, as one would expect, almost always show a higher infection rate for diabetic patients[8,14]. This would make sense as a diabetic patient would most likely be more vulnerable to a wound infection than his or her counterpart due to such things as his or her blood sugar levels. With this unusual statistic, I thought maybe the size of the sample (463 patients) was not large enough. Some of the other studies had sample sizes of 63,000 patients, so I felt that maybe this difference in sample size might have accounted for the lower rate in the diabetic patients.

Many of the statistics and results from this study (e.g.,wound infection rate, clean wound rate, etc.) were very comparable to the results obtained in the larger studies. Therefore, there is no specific statistical test that could explain the anomaly of the diabetic patients. Maybe the sample that I studied was at the low extreme of a test like the student T test, due to some incidental occurrence like a low number of diabetic patients in the sample area at the time of the study. The only way to account for a statistic like this one is through continued sampling over a longer time period because of the small size of Hospital A.

Concerning the time when wound infection became apparent, it proved valuable for us to do a follow up study on the patients (28th day survey), as 23.53% of the infections were detected with the follow up phone call.

In the categories of wound class, with respect to infection, Hospital A's rates are reflective of other studies that have been done. The clean wound infection rate was 4.23%, the clean-contaminated rate was 7.47%, the contaminated rate was 12.77%, and the dirty rate was 20.69% (Refer to Totals Table, page 24). These rates are expected to rise with the degree of contamination, and the only variation of significance is that the clean wound infection rate should be lower (1-2%)[8]. Again, however, if you look at the clean wound infection rate in a month-by-month analysis, you will see that the rate steadily declined (as the overall wound infection rate did).

With respect to patients treated with antibiotics and/or steroids before surgery, some interesting statistics have also turned up. Patients who were given pre-operative antibiotics had an overall wound infection rate of 9.28%, while patients that were given neither steroids nor antibiotics before surgery had an overall infection rate of 6.93% (Refer to Totals Table, page 24). In order to account for this statistic, one would have to go back and check the

reasons why or why not the patient was given pre-operative antibiotics. No patients who were given steroids before surgery had an infection rate, but there were only five patients who received this type of treatment during the study. Steroids are given to patients as anti-inflammatory or immunosuppressive agents as they impair the mobilization, adherence, phagocytosis, and bactericidal activity of neutrophils, monocytes, and macrophages. They also depress B- and T-lymphocyte activity, diminish production of interferon, and alter the gastrointestinal flora and local tissue integrity, resulting in easier invasion by endogenous flora. High dose steroids can be well tolerated for up to three weeks, but after that the incidence of life-threatening infection is increased[8]. Again, the figure in this study concerning steroids and infection might be attributed to an extreme statistic, and only through further study will the validity of this type of statistic become apparent.

The most interesting factor in this study, I feel, turned out to be the infection rates in the anesthesia risk categories. The class 1 patients had an overall rate of 1.16%, the class 2 patients, had a rate of 7.47%, the class 3 patients had a rate of 8.40%, and the class 4 patients had a rate of 12.50% (Refer to Totals Table, page 24). Like the wound class categories, as a patient's status made him or her more vulnerable to infection (like class 4 anesthesia patients), the overall wound infection rate goes up. This is certainly an aspect that would be expected in a wound infection rate study, but it is also an aspect that I feel has been overlooked. With the medical world's continual emphasis on asepsis and aseptic technique, almost all of the study that has gone into infection rates in wounds has been in areas such as the surgeon's hands, drapings, proper shaving techniques, and operating room sites. More attention should be given to the status of the patient when one

is looking at infection rates. For example, in Hospital A, a study could be made stratifying individual surgeons and then looking at their rates with respect to anesthesia risk category (Refer to Totals Table, page 24). By being aware of a patient's vulnerabilities, a hospital could take certain precautions that could significantly reduce the infection rate. Granted, statistics about a surgeon's clean wound infection rate are important. However, information about a patient's anesthesia risk category can also be helpful to a hospital and to surgeons when working to reduce wound infection rates.

Overall, I feel this study is just a beginning, and that other studies of this type should be made since it is difficult to stratify tendencies in wound infection rates with only 463 surgeries. Data gathered from patients in an extended study would increase the patient sample size; and further analysis may improve the reliability of results from a study for a hospital the size of Hospital A. It will be interesting to know if our findings about the low infection rate for diabetic and steroidal patients is characteristic of Hospital A or the geographical region or if it is due to some other factor particular to this present study.

In any event, studies of this kind yield information that is valuable in a hospital's attempt to know about and to reduce infections resulting from surgical wounds. As this study goes on and more information is acquired and analyzed, I feel this study will reveal many interesting things concerning wound infections and will become a very helpful tool in Hospital A's attempt to reduce infections in surgical wounds.

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THESES - 1990

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