Cost Analysis of Preoperative Nasal Decolonization with Povidone-Iodine for Closed Pilon Fractures

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INTRODUCTION: Pilon fractures make up 1-5% of lower extremity fractures and 7-10% of all tibia fractures. Postoperatively, the deep infection rate may be as high as 17% in closed pilon injuries. Nasal decolonization using mupirocin and chlorhexidine gluconate solutions prior to elective orthopaedic surgery such as arthroplasty and spine has been shown to be effective in decreasing postoperative infections; however, nasal decolonization in trauma cases is difficult, as mupirocin is expensive and requires a 5-day application period prior to surgery. Nasal povidone-iodine (NP-I) solution has shown similar efficacy to nasal mupirocin, even when used two hours prior to surgical incision. NP-I also costs approximately 1/6 the price of mupirocin, making it significantly more cost-effective for decreasing infection rates. The purpose of this study is to determine if the use of NP-I in the preoperative holding area to decrease the historical rate of infection associated with operative fixation is cost-effective for closed pilon fractures.

METHODS: A break-even equation (Figure 1) was used to analyze the institutional costs associated with NP-I and postoperative infection following closed pilon fractures. This equation produced a new infection rate, which defines the percentage NP-I needs to decrease the initial infection rate for its use in the preoperative holding area to be cost-effective. The postoperative infection rate used in this study was 17%, which is a value established by current literature for closed pilon fractures. The institutional costs associated with a single operative debridement and inpatient stay were also determined, and a sensitivity analysis was conducted to demonstrate how various costs of treating infection and how varying primary infection rates affect the break-even rate, the absolute risk reduction (ARR), and the number needed to treat (NNT).

RESULTS:

The business office at our institution yielded the average total cost of treating infection, which was $18,912 (Table 1). The cost of NP-I was determined to be $360/12 units, or $30/unit. Utilizing the break-even formula with these costs and a 17% initial infection rate, NP-I was economically viable if it decreased infection rates by 0.0016% (NNT = 63,051.7). The sensitivity analysis utilizing varying rates of infection shows that as the historical rate of infection is increased or decreased, the ARR and NNT stay the same (Table 2). The sensitivity analysis utilizing varying costs of treating infection demonstrates that as costs increase, ARR decreases and NNT increases (Table 3).

DISCUSSION AND CONCLUSION: This break-even model suggests that the use of NP-I in the preoperative holding area is cost-effective for decreasing the rate of infection associated with the treatment of closed pilon fractures.

Figure 1. Break-even equation

$$IRf = \frac{(IRixCt) - Cp}{Ct}$$

IRf=Break-even infection rate
IRi=Initial (current) infection rate without nasal povidone-iodine
Ct=Total cost of treating infection
Cp=Added cost of nasal povidone-iodine

Table 1. Total cost of treating infection (*Ct*)

	Cost ($)	Needed
Room and board	6,981	1
Pharmacy	1,659	1
OR services and anesthesia	9,683	1
Laboratory fees	180	1
Radiology	226	1
PT/OT	87	1
ER/Physician visit	96	1
	18,912	

Table 2. Maintaining the cost of the nasal povidone-iodine and cost of treating infection constant while varying initial infection rates

Rate of Infection (%)	Break-even (%)	ARR (%)	NNT
5	4.99841	0.001586	63,051.7
10	9.99841	0.001586	63,051.7
17	16.99841	0.001586	63,051.7
20	19.99841	0.001586	63,051.7
25	24.99841	0.001586	63,051.7

ARR: absolute risk reduction
NNT: number needed to treat

Table 3. Maintaining the cost of the nasal povidone-iodine and initial infection rate constant while varying the cost of treating infection

Cost ($)	Break-even (%)	ARR (%)	NNT
5,000	16.994	0.006	16,666.67
10,000	16.997	0.003	33,333.33
15,000	16.998	0.002	50,000
18,912	16.99841	0.001586	63,051.7
25,000	16.9988	0.0012	83,333.33

ARR: absolute risk reduction
NNT: number needed to treat