*Perspective*

# Economics of Preventing Hospital Infection

**Nicholas Graves***
*Centre for Health Research and Public Health, Queensland University of Technology, Kelvin Grove, Brisbane, Australia

## Online Appendices

## Appendix 1. Calculating the gross costs of hospital-acquired infection

### Assumptions

Available bed-days = 525,000
Length of stay for patients without hospital-acquired infection (HAI) = 10 days
Length of stay for patients with HAI = 15 days
Revenue earned per patient treated = $1,250

### Calculations

| | | | |
|---|---|---|---|
| (1) Incidence of wound infection | 10% | 5% | 0% |
| (2) Total admissions[a] | 50,000 | 51,220 | 52,500 |
| (3) Number of patients that acquire HAI[b] | 5,000 | 2,561 | 0 |
| (4) Number of patients that do not acquire HAI[c] | 45,000 | 48,659 | 52,500 |
| (5) Bed-days used by those that do not acquire HAI[d] | 450,000 | 486,590 | 525,000 |
| (6) Bed-days used by those that acquire HAI[e] | 75,000 | 38,415 | 0 |
| (7) Revenue earned from all admissions[f] | $62,500,000 | $64,025,000 | $65,625,000 |
| (8) Gross cost (loss of revenue due to the incidence of HAI)[g] | $3,125,000 | $1,600,000 | $0 |

[a]The number of admissions that can be treated with the 525,000 bed-days available at that incidence rate. We calculate this figure by dividing 525,000 (available bed-days) by the rate of infection times 15 days plus the rate of noninfection times 10 days. For example, at 10% incidence, 525,000 / ([10% x 15] + [90% x 10]) = 525,000 / (1.5 + 9) = 50,000.
[b]Calculated by (1) x (2).
[c]Calculated by (2) – (3).
[d]Calculated by (4) x 10 days.
[e]Calculated by (3) x 15 days.
[f]Calculated by (2) x $1,250.
[g]Calculated by ([7] at 0%) – ([7] at 10%) and ([7] at 0%) – ([7] at 5%); these data are used to plot Line B1 in Figure 1.

## Appendix 2. Calculating the net costs of hospital-acquired infection

### Assumptions

The change in the variable costs attributable to a case of hospital-acquired infection (HAI) is $100. The change in variable costs attributable to a new admission is $750.

### Calculations

| Incidence of wound infection | 10% | 5% | 0% |
|---|---|---|---|
| (1) Total admissions achieved[a] | 50,000 | 51,220 | 52,500 |
| (2) Extra cases that could be treated if incidence was 0%[b] | 2,500 | 1,280 | 0 |
| (3) Number that acquire HAI[a] | 5,000 | 2,561 | 0 |
| (4) Lost revenue (gross cost of HAI)[a] | $3,125,000 | $1,600,000 | $0 |
| (5) Additional variable costs if extra cases were treated[c] | $1,875,000 | $960,000 | $0 |
| (6) Incremental variable costs for each case of infection[d] | $500,000 | $256,100 | $0 |
| (7) Net cost of HAI[e] | $1,750,000 | $896,100 | $0 |

[a]See Appendix 1 for details of how this figure is derived.
[b]Calculated by ([1] at 0%) – ([1] at 10%) and ([1] at 0%) – ([1] at 5%).
[c]Calculated by (2) x $750.
[d]Calculated by (3) x $100.
[e]Calculated by (4) + (6) – (5); these data are used to plot Line B2 in Figure 1.

## Appendix 3. The values for lines A, B2, and C between incidence rates of 2.9% and 3.4%

### Notes

1. Reducing incidence from 3.3% to 3.2% causes the net cost of hospital infection (line B2 on Figure 1) to fall from $596,532 to $578,740, an incremental savings of $17,792.
2. The cause of this reduction in incidence from 3.3% to 3.2% is an incremental investment in prevention (line A on Figure 1). The costs of prevention rise from $626,157 to $643,487, an incremental cost of $17,330.
3. Costs have increased by $17,330 but have been offset by a saving of $17,792. Total costs (line C on Figure 1) have fallen from $1,222,689 to $1,222,227, a net saving of $462.
4. Economists would support the practices that lead to the reduction in rates from 3.3% to 3.2% as savings exceed costs by $462.

### Notes

1. Reducing incidence beyond the optimum, from 3.1% to 3.0%, also reduces the net costs of hospital infection (line B2 on Figure 1) from $560,931 to $543,103, an incremental saving of $17,827.
2. The cost of achieving this reduction is the change in costs of prevention (line A on Figure 1) from $661,297 to $679,599, an incremental cost of $18,302.
3. In this case, in which rates of hospital infection are lower than the optimum, as defined by point X, the costs of the reduction are not completely offset by the benefits. Total cost (line C on Figure 1) rises from $1,222,227 to $1,222,703, an increase of $476.
4. Although infection rates are further reduced, economists would not support the practices that lead to this reduction in incidence from 3.1% to 3.0%. More has been lost than has been gained with costs exceeding savings by $476.

### Data

| Incidence | Net cost of infection and potential cost saving (line B1) | Cost of prevention (line A) | Total cost (line C) | Incremental cost saving | Incremental cost | Change in total cost |
|---|---|---|---|---|---|---|
| 2.90% | $525,259 | $698,408 | $1,223,667 | | | |
| | | | | $17,845 | $18,809 | $964 |
| 3.00% | $543,103 | $679,599 | $1,222,703 | | | |
| | | | | $17,827 | $18,302 | $476 |
| 3.10% | **$560,931** | **$661,297** | **$1,222,227** | | | |
| **Point X** | | | | **$17,810** | **$17,810** | **$0** |
| 3.20% | $578,740 | $643,487 | $1,222,227 | | | |
| | | | | $17,792 | $17,330 | –$462 |
| 3.30% | $596,532 | $626,157 | $1,222,689 | | | |
| | | | | $17,775 | $16,863 | –$912 |
| 3.40% | $614,307 | $609,294 | $1,223,601 | | | |

## Appendix 4. Calculating Incremental Cost-Effectiveness Ratios (ICERs)

### Compared to Status Quo

| | |
|---|---|
| ICER for option 6 as compared to status quo = $154[a] | $\frac{\text{IC[b] of option 6 (\$299,611) – IC of the status quo (\$0)}}{\text{IB[b] of option 6 (1,942 patients) – IB of the status quo (0 patients)}}$ |
| ICER for option 3 as compared to status quo = $434 | $\frac{\text{IC of option 3 (\$523,487) – IC of the status quo (\$0)}}{\text{IB of option 3 (1,205 patients) – IB of the status quo (0 patients)}}$ |
| ICER for option 2 as compared to status quo = $192 | $\frac{\text{IC of option 2 (\$643,487) – IC of the status quo (\$0)}}{\text{IB of option 2 (3,346 patients) – IB of the status quo (0 patients)}}$ |
| ICER for option 5 as compared to status quo = $236 | $\frac{\text{IC of option 5 (\$812,457) – IC of the status quo (\$0)}}{\text{IB of option 5 (3,348 patients) – IB of the status quo (0 patients)}}$ |
| ICER for option 1 as compared to status quo = $826 | $\frac{\text{IC of option 1 (\$874,512) – IC of the status quo (\$0)}}{\text{IB of option 1 (1,059 patients) – IB of the status quo (0 patients)}}$ |
| ICER for option 4 as compared to status quo = $225 | $\frac{\text{IC of option 6 (\$892,931) – IC of the status quo (\$0)}}{\text{IB of option 6 (3,960 patients) – IB of the status quo (0 patients)}}$ |

### Compared to Option 6

| | |
|---|---|
| ICER for option 3 as compared to option 6[c] = –$304 | $\frac{\text{IC of option 3 (\$523,487) – IC of option 6 (\$299,611)}}{\text{IB of option 3 (1,205 patients) – IB of option 6 (1,942 patients)}}$ |
| ICER for option 2 as compared to option 6[d] = $245 | $\frac{\text{IC of option 2 (\$643,487) – IC of option 6 (\$299,611)}}{\text{IB of option 2 (3,346 patients) – IB of option 6 (1,942 patients)}}$ |
| ICER for option 5 as compared to option 6 = $340 | $\frac{\text{IC of option 5 (\$812,457) – IC of option 6 (\$299,611)}}{\text{IB of option 5 (3,348 patients) – IB of option 6 (1,942 patients)}}$ |
| ICER for option 1 as compared to option 6[c] = –$651 | $\frac{\text{IC of option 1 (\$874,512) – IC of option 6 (\$299,611)}}{\text{IB of option 1 (1,059 patients) – IB of option 6 (1,942 patients)}}$ |
| ICER for option 4 as compared to option 6 = $294 | $\frac{\text{IC of option 6 (\$892,931) – IC of option 6 (\$299,611)}}{\text{IB of option 6 (3,960 patients) – IB of option 6 (1,942 patients)}}$ |

### Compared to Option 2

| | |
|---|---|
| ICER for option 5 as compared to option 2 = $1,664 | $\frac{\text{IC of option 5 (\$812,457) – IC of option 2 (\$643,487)}}{\text{IB of option 5 (3,448 patients) – IB of option 2 (3,346 patients)}}$ |
| ICER for option 4 as compared to option 6[e] = $406 | $\frac{\text{IC of option 4 (\$892,931) – IC of option 2 (\$643,487)}}{\text{IB of option 4 (3,960 patients) – IB of option 2 (3,346 patients)}}$ |

[a]The most cost-effective as compared to status quo.
[b]IC, incremental cost; IB, incremental benefit.
[c]More costly and less effective than another available option.
[d]The most cost-effective as compared to option 6.
[e]The most cost-effective as compared to option 2.