

Reducing Hospital-Acquired *Clostridium difficile* Infections Using a Novel Mattress Barrier: A Cost Analysis

Dominique M. Brandt, MS¹; France Weaver, PhD¹; Peter J. Mallow, PhD¹; Edmond A. Hooker, MD^{1,2}

¹Xavier University, Cincinnati, OH; ²Trinity Guardion, Batesville, IN

Background



- *Clostridium difficile* infection (CDI) is a common healthcare-associated infection transmitted by oral fecal route.
- Despite strict cleaning guidelines, the hospital bed mattress remains an area of potential contamination.
- A launderable mattress barrier (MB), is a solution to reduce the incidence of hospital-acquired CDI (HA-CDI).

Project Aim

This study compared the cost of two methods to reduce hospital-acquired *Clostridium difficile* infections (HA-CDI): the use of a mattress barrier and current mattress cleaning practice.

Methods

- A simulation model assumed that the mattress barrier has two main consequences for hospitals:
 - a reduction in the incidence of HA-CDI, and
 - an extension in the hospital bed mattress life.
- Clinical and cost data were obtained from the peer-reviewed literature and materials from the mattress barrier manufacturer.
- All incidence rates of HA-CDI and costs were reported per patient bed day.
- Sensitivity analyses assessed the robustness of the results to various values of the model's parameters.
- A scenario analysis examined the cost consequences of the mattress barrier in a hospital with:
 - high HA-CDI rates: at the 75th percentile
 - low HA-CDI rates: at the 25th percentile.

Figure 1: Model

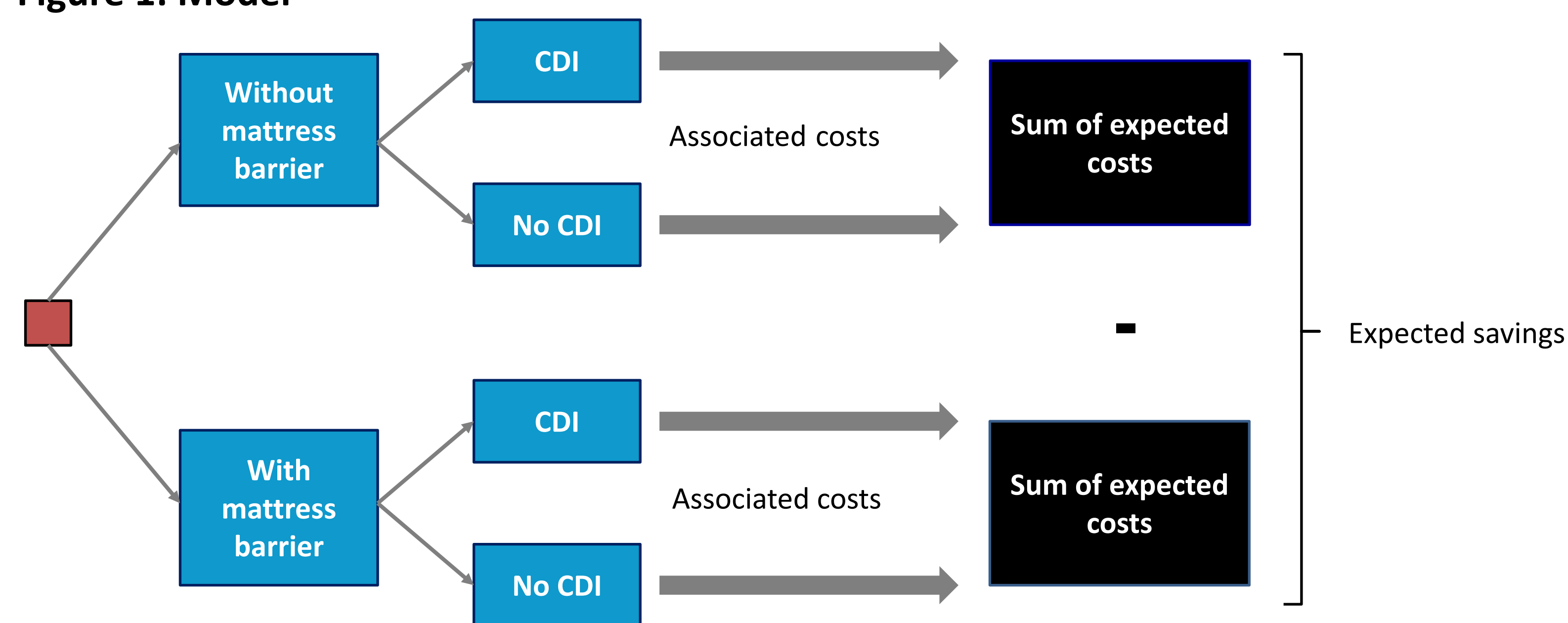


Table 1: Model Parameters

Variables	Base case ^(a)	Range ^(b)	Distribution ^(c)
Hospital occupancy rate ⁽¹⁾	0.6280	0.47 - 0.79	Normal
Probabilities			
Probability CDI-related ^(d) bed day ^(2,3)	0.0052	0.0046 - 0.0059	Beta
Proportion of CDI reduction attributable to MB ⁽⁴⁾	0.50	0.47 - 0.53	Beta
Length of stay			
CDI-related length of stay ⁽⁵⁾	8.01	7.83 - 8.17	Gamma
Overall inpatient length of stay ⁽³⁾	4.6	4.03 - 5.18	Gamma
Costs of inpatient care per bed			
CDI-related inpatient cost ⁽⁵⁾	3671	3,490 - 3,938	Gamma
Overall inpatient cost (excluding CDI) ^(5,3)	2257	1,750 - 2,750	Gamma
Costs related to mattress/skin			
Cost of one mattress ^(7,8)	800	300 - 3,200	Gamma
Years of mattress life ⁽⁹⁾	4	3 - 5	...
Extension in mattress/skin life year(s) attributable to MB ⁽⁹⁾	1	0 - 2	Normal
Time to clean a mattress in minutes (no CDI) ⁽⁹⁾	5	3 - 10	...
Time to clean a mattress in minutes after CDI ⁽⁹⁾	10	5 - 15	...
Cost of standard cleaning products, per discharge ⁽¹⁰⁾	0.41	0.31 - 0.51	...
Cost of enhanced cleaning product after CDI, per discharge ⁽¹⁰⁾	0.69	0.52 - 0.86	...
Costs related to mattress barrier (MB)			
Cost of one MB ⁽⁹⁾	400	350 - 600	Gamma
Cost of labor per hour, including benefits ⁽¹¹⁾	18	12 - 24	Normal
Time to change MB in minutes ⁽⁹⁾	4	2 - 6	Normal
Cost of one MB laundry wash ⁽⁹⁾	5	4 - 8	Gamma
Number of MB changes per CDI patient ⁽⁹⁾	3	1 - 5	...
Number of MB changes per non-CDI patient ⁽⁹⁾	1.5	1 - 2	...
Number of possible washes per cover ⁽⁹⁾	200	150 - 250	Normal

(a) All costs reported per patient bed day and in 2016 prices.

(b) The range represents the 95% confidence interval when available, or ±25% of the base case value. Deterministic sensitivity analysis conducted on each range.

(c) Shape of distribution selected based on best practice. When the distribution is provided, the parameter was entered into the probabilistic sensitivity analysis. If not provided, the deterministic sensitivity analysis showed that the parameter's values had no impact on the results. In that case, that parameter was not part of the probabilistic sensitivity analysis.

(d) There is no distinction between hospital and community acquired CDI in the model parameters.

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Results

Key parameters' values are the following (Table 1):

- Probability of HA-CDI: 52 per 10,000 bed days.
- Reduction in HA-CDI rates attributable to mattress barrier: 50 percent.
- Inpatient care costs in the presence of HA-CDI: \$3,671 per bed day.

Table 2. Expected Costs of Mattress Barrier and Current Practice per Bed Day

Current Practice (CP)	With HA-CDI	No HA-CDI	Expected Cost
Probabilities	0.0052	0.9948	
Cost of inpatient stay	3,670.55	2,257.21	2,264.52
Cost of mattress	0.87	0.87	0.87
Cost of mattress skin	0.58	0.58	0.58
Cost of cleaning mattress and skin	0.46	0.42	0.42
Expected CP Cost	19.24^a	2,247.12^a	2,266.39^b
Mattress Barrier (MB)			
Probabilities	0.0026	0.9974	
Cost of inpatient stay	3,670.55	2,257.21	2,260.88
Cost of mattress	0.70	0.70	0.70
Cost of mattress skin	0.35	0.35	0.35
Cost of cleaning mattress and skin	0.46	0.42	0.42
Cost of buying MB	0.75	0.65	0.65
Cost of changing MB	0.45	0.39	0.39
Cost of laundering MB	1.87	1.63	1.63
Expected MB Cost	9.65^a	2,255.28^a	2,265.02^b
Expected Savings			1.49^c

(a) Expected cost = probability x total cost

(b) Expected cost with HA-CDI + Expected cost No HA-CDI

(c) Expected CP cost - Expected MB cost

For a typical hospital, the mattress barrier was associated with an expected average cost reduction of \$1.49 per patient bed day (Table 2).

Figure 2: Impact of mattress barrier for a hospital with 100,000 bed days per year

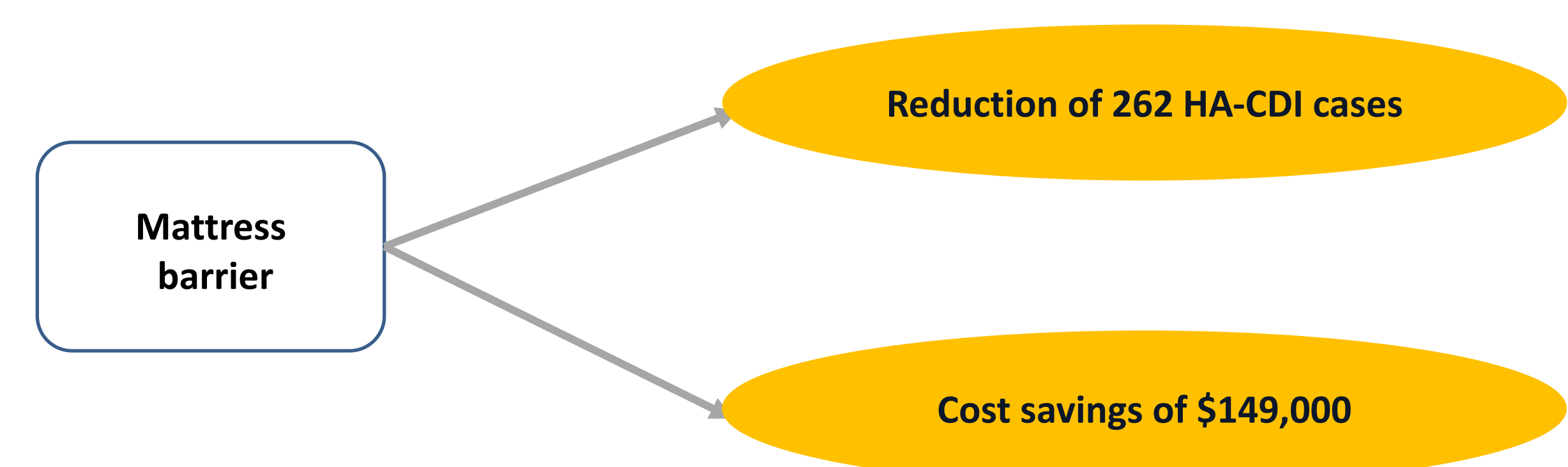
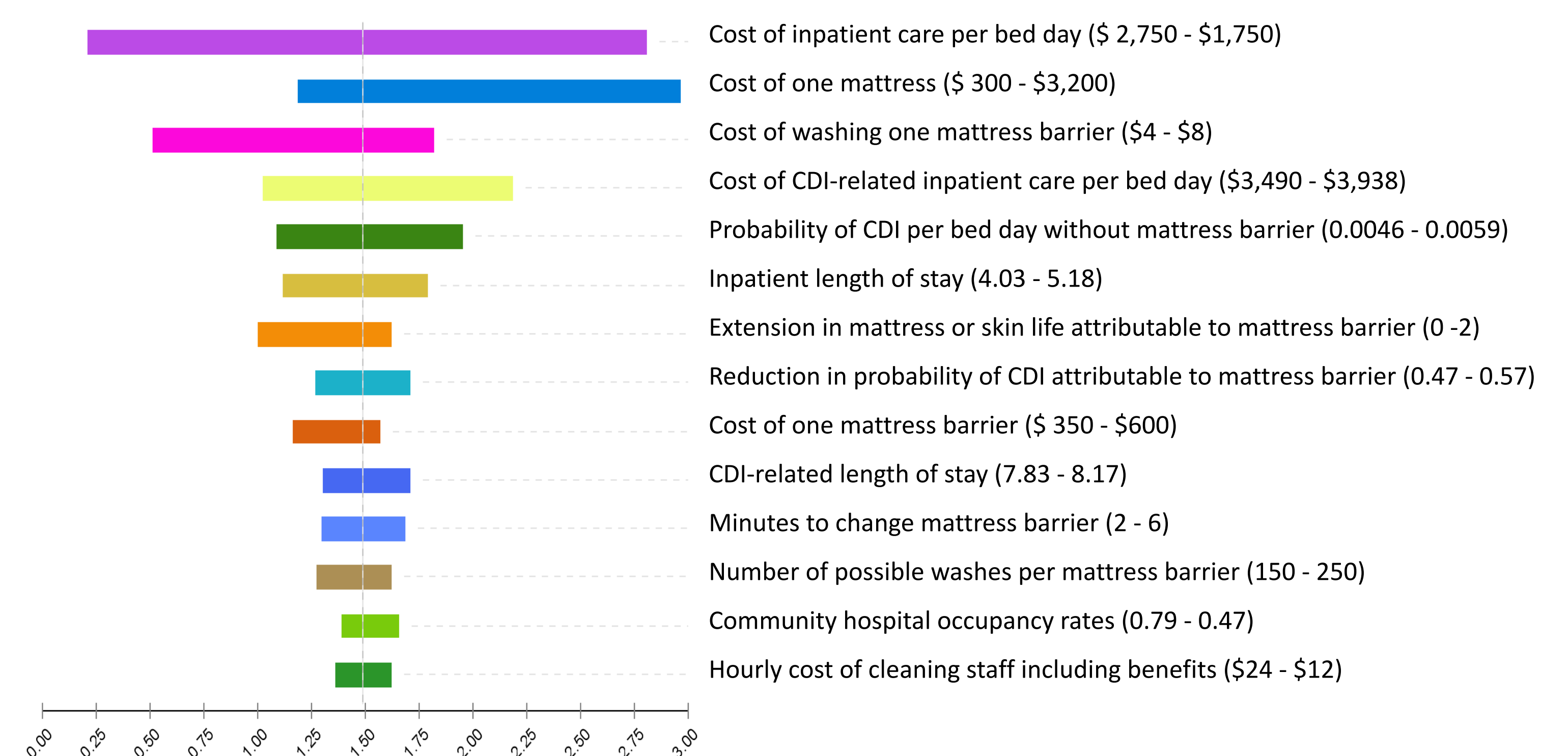


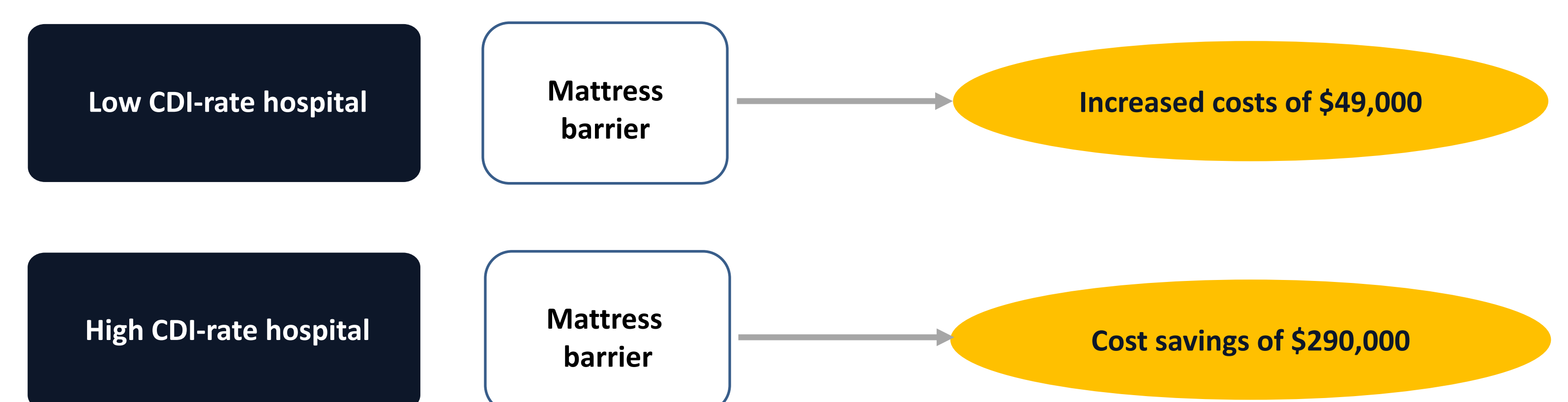
Figure 3: Sensitivity Analysis



The factors impacting the most the level of cost savings are (Figure 3):

- inpatient care costs with or without HA-CDI
- cost of the mattress
- costs of cleaning the mattress barrier.
- The mattress barrier generated expected savings in 99.99% of the model iterations.

Figure 4: Scenario analysis for a hospital with 100,000 bed days per year



Conclusion

- The use of a mattress barrier was expected to be a cost reduction measure for most hospitals.
- The savings resulted mainly from the reduction in the HA-CDI rates.
- A mattress barrier is an intervention that
 - does not require changes in cleaning or other hospital protocols, contrary to other CDI interventions
 - may be a comparatively simple solution to reduce HA-CDI for hospitals.

Next Steps

Further investigations could help determine whether a mattress barrier would:

- reduce other hospital-acquired infections
- be cost-effective from a societal perspective.

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