SUPPLEMENTARY FILES

A Discrete Event Simulation Model of Patient Flow in a General Hospital Incorporating Infection Control Policy for Methicillin-Resistant *Staphylococcus Aureus* (MRSA) and Vancomycin-Resistant *Enterococcus* (VRE)

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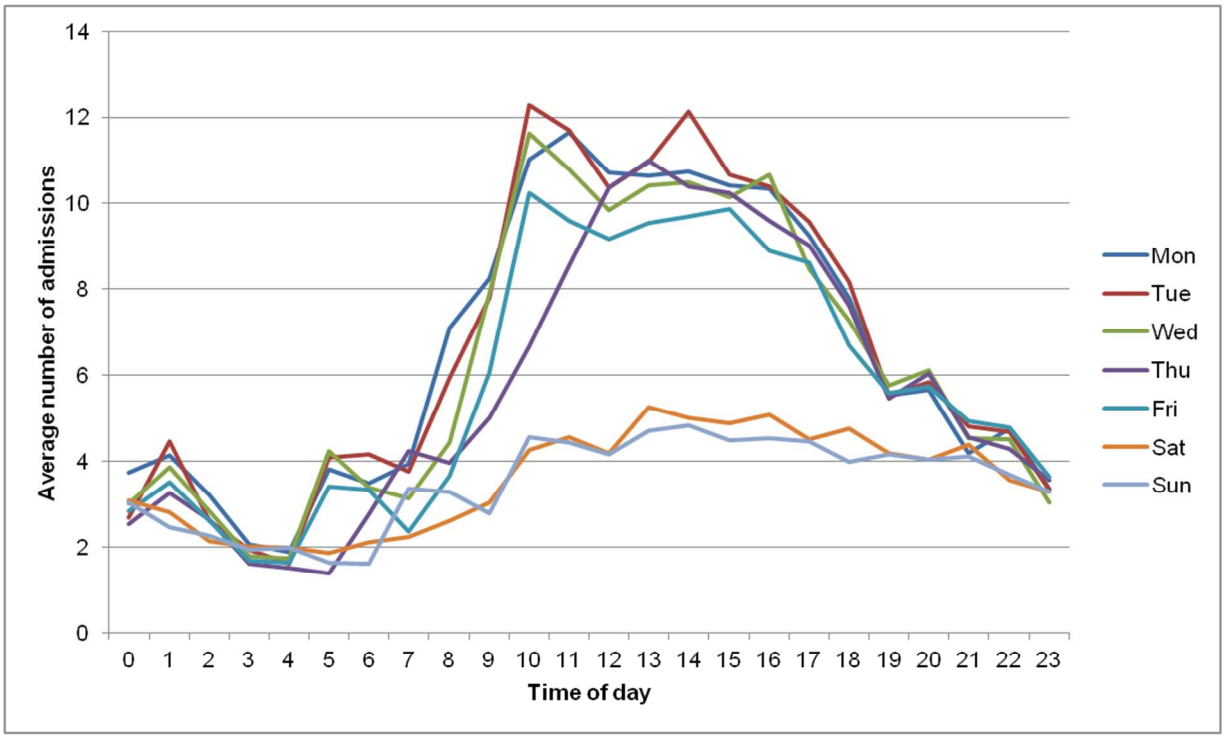

Figure 1S: Hourly admissions by hour of day and day of week. The average number of admissions by time of day and day of week are shown. Two trends are apparent: one among admissions on weekdays and one among admissions on weekends. For this reason, the admissions input was broken down into weekdays and weekends.

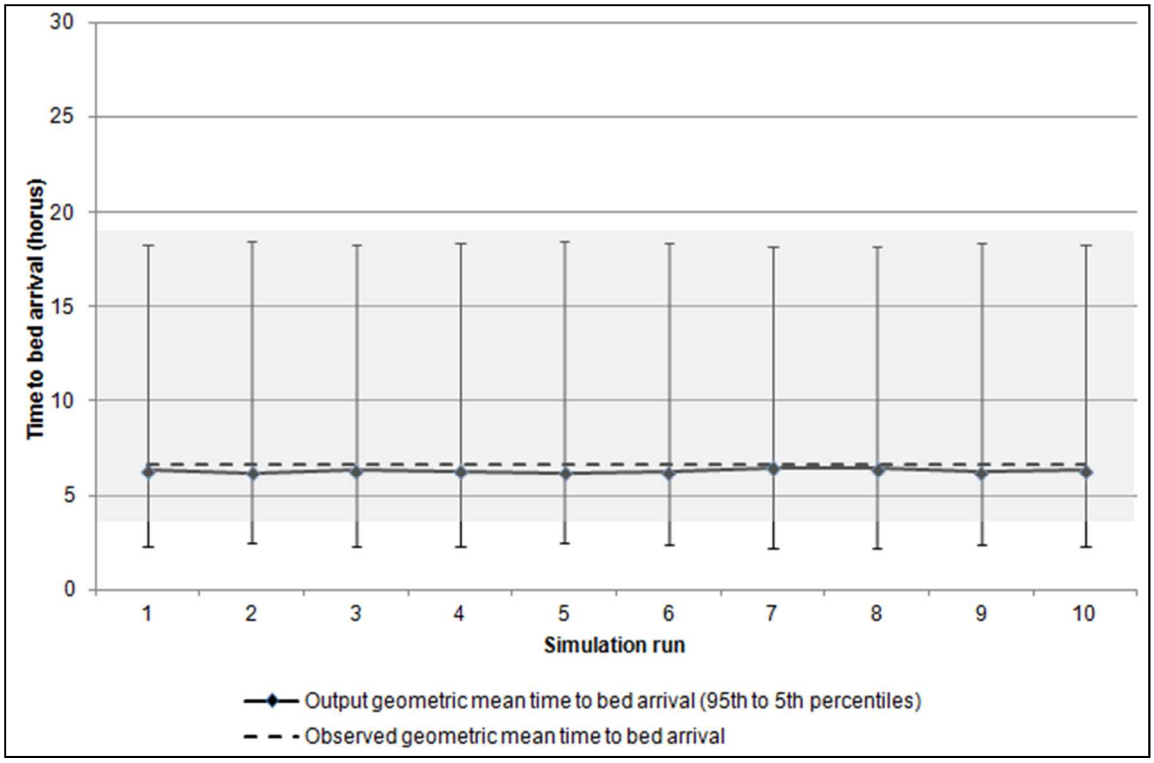

Figure 2S. Time to bed arrival. The observed geometric mean time to bed arrival (6.7 hours) is compared to the geometric mean time to bed arrival model outcome across ten individual simulation runs, along with the 90% coverage interval for the simulated data range within each run. The 90% coverage interval (3.7-18.7 hours) around the observed geometric mean time to bed arrival is shaded. The coefficient of variation (standard deviation standardized to its own mean) across the ten simulation runs was 1.4%.

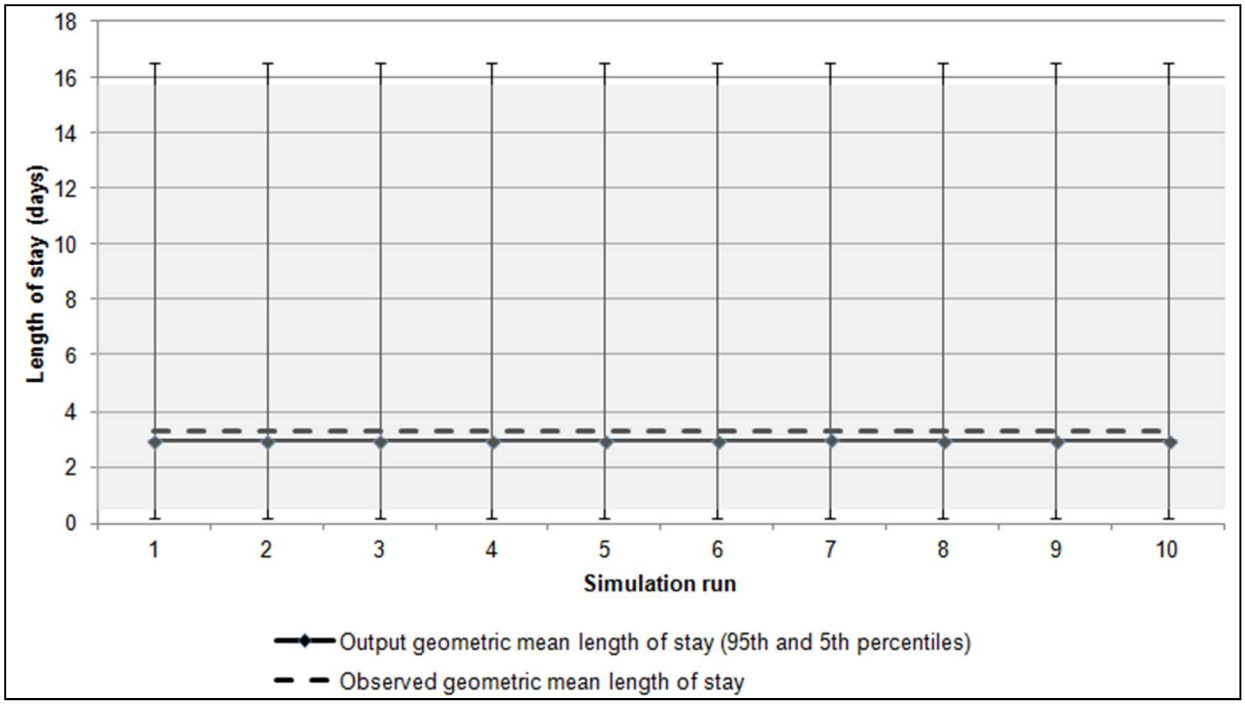

Figure 3S: Length of stay. The observed geometric mean length of stay (3.3 days) is compared to the geometric mean length of stay model outcome across ten individual simulation runs, along with the 90% coverage interval for the simulated data within each run. The 90% coverage interval (1.0-16.1 days) around the observed mean length of stay is shaded. The coefficient of variation (standard deviation standardized to its own mean) across the ten simulation runs was 0.4%.

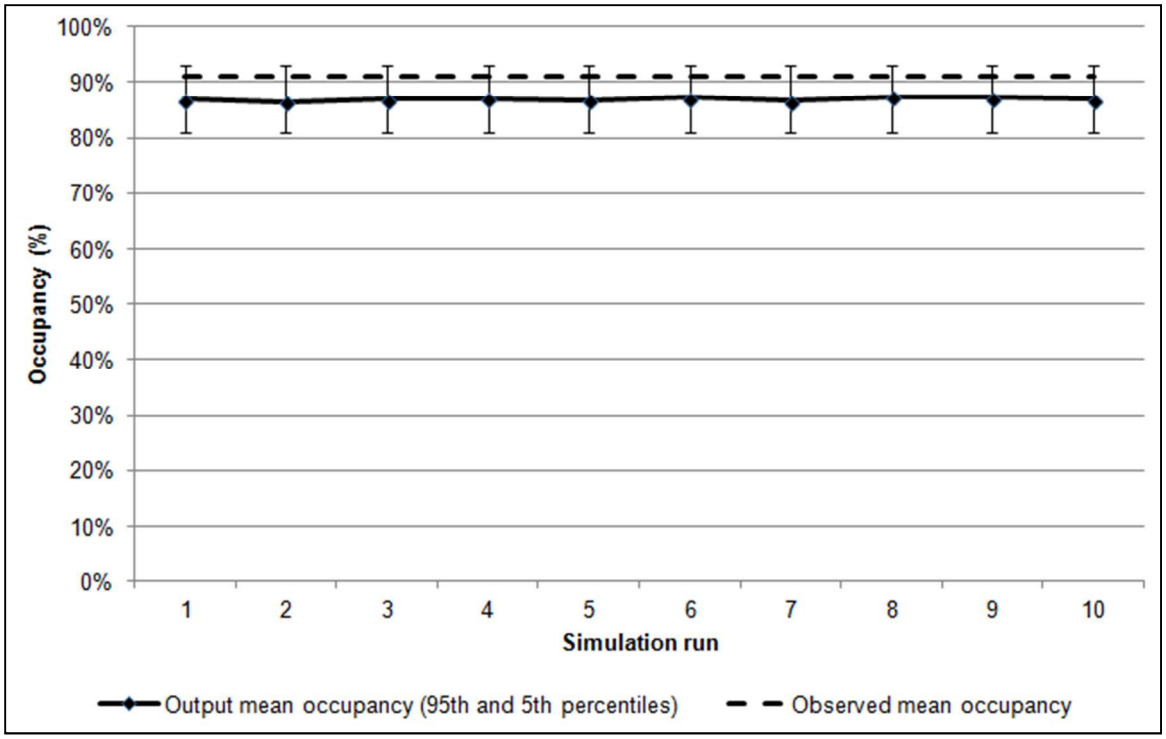

Figure 4S. Occupancy. The observed mean occupancy (91%) is compared to the mean occupancy model outcome across ten individual simulation runs, along with markers showing the 90% coverage interval of each run. There is no 90% coverage interval presented for observed data, which were available as a single mean occupancy over the entire two year data collection period. The coefficient of variation (standard deviation standardized to its own mean) across the ten simulation runs was 0.3%.

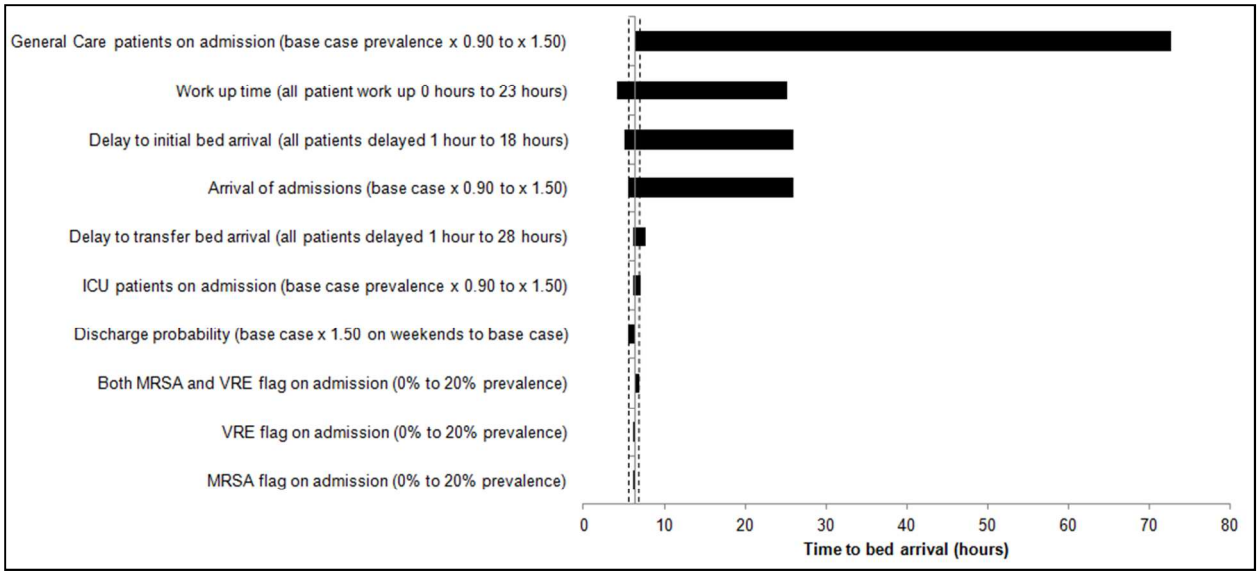

Figure 5S. Results of one-way sensitivity analysis around time to bed arrival. Shown are the effects of altering various input parameters on the time to bed arrival model output. The solid vertical line indicates the mean base case value (6.3 hours) across ten 1-year runs. On either side of this line are two dotted lines indicating the range across the ten 1-year base case runs. Each horizontal bar represents a single input parameter being altered, with the length of each bar representing the range of time to bed arrival over the specified values for each input parameter modified.

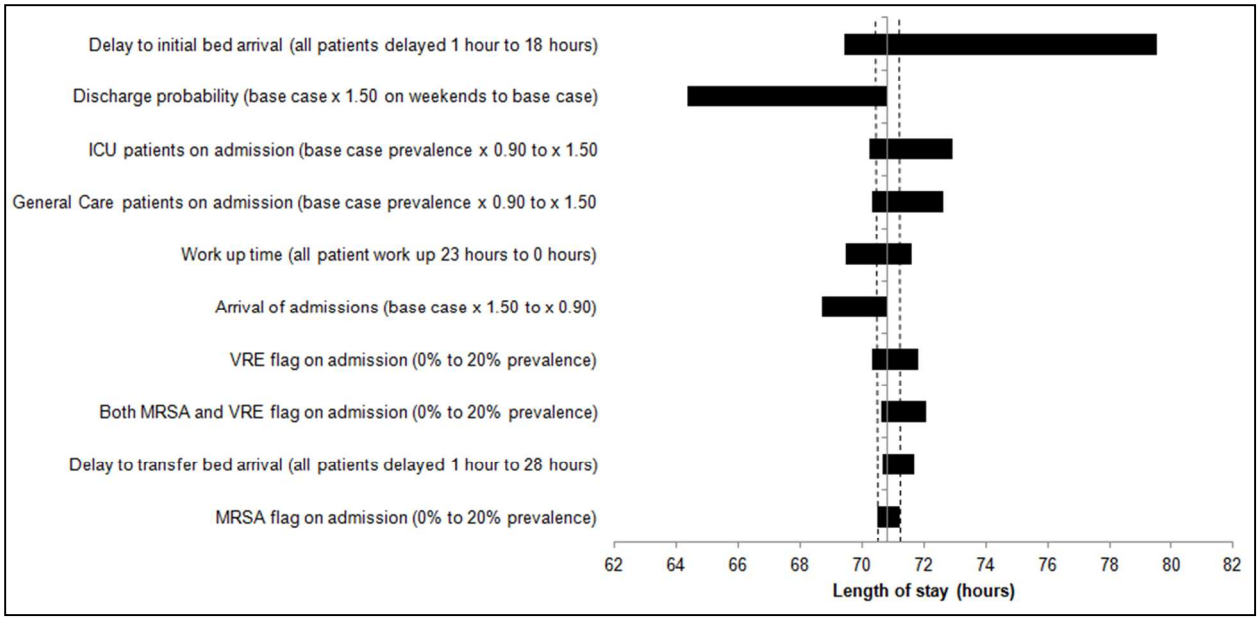

Figure 6S. Results of one-way sensitivity analysis around length of stay. Shown are the effects of altering various input parameters on the length of stay model output. The solid vertical line indicates the mean base case value (70.8 hours) across ten 1-year runs. On either side of this line are two dotted lines indicating the range across the ten 1-year base case runs. Each horizontal bar represents a single input parameter being altered, with the length of each bar representing the range of length of stay over the specified values for each input parameter modified.

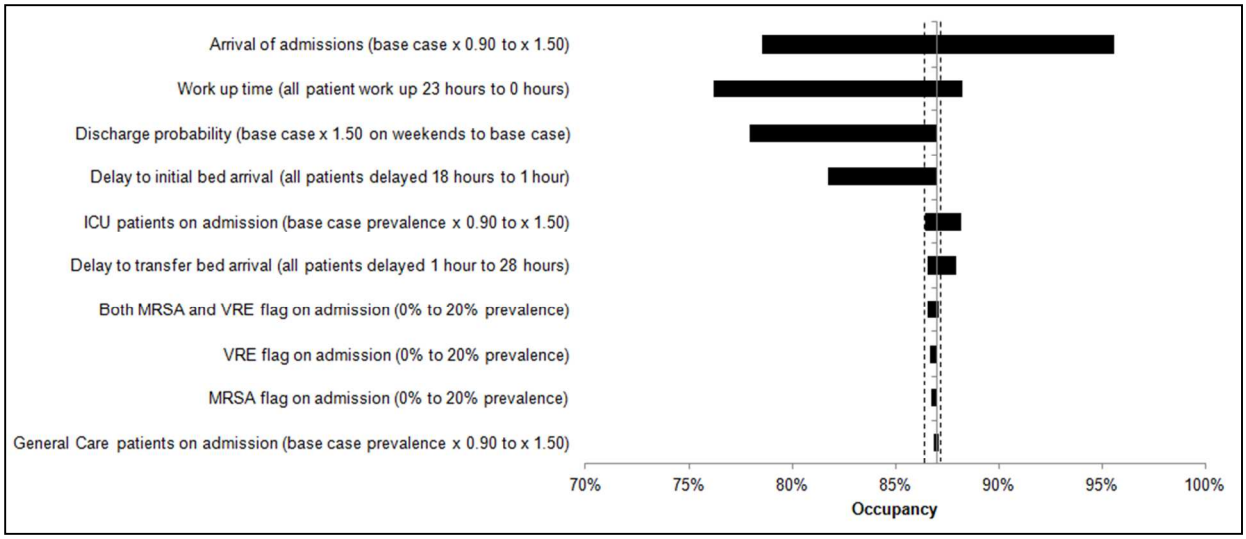

Figure 7S. Results of one-way sensitivity analysis around occupancy.
Shown are the effects of altering various input parameters on the occupancy model output. The solid vertical line indicates the mean base case value (87%) across ten 1-year runs. On either side of this line are two dotted lines indicating the range across the ten 1-year base case runs. Each horizontal bar represents a single input parameter being altered, with the length of each bar representing the range of occupancy over the specified values for each input parameter modified.

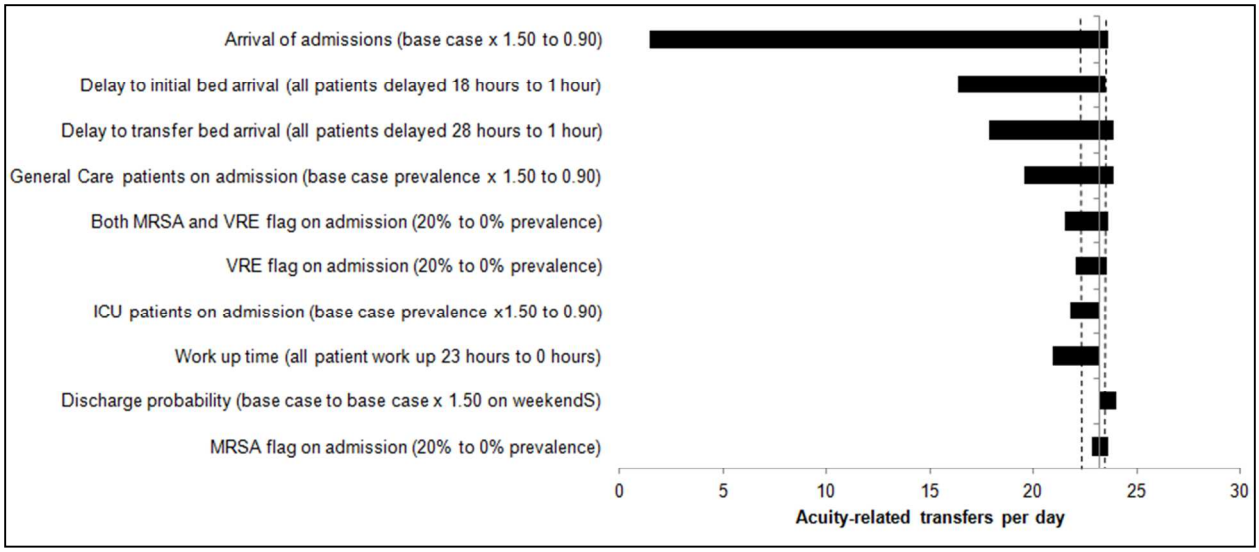

Figure 8S. Results of one-way sensitivity analysis around acuity-related transfers. Shown are the effects of altering various input parameters on the acuity-related transfers model output. The solid vertical line indicates the mean base case value (23.2 acuity-related transfers per day) across ten 1-year runs. On either side of this line are two dotted lines indicating the range across the ten 1-year base case runs. Each horizontal bar represents a single input parameter being altered, with the length of each bar representing the range of acuity-related transfers per day over the specified values for each input parameter modified.

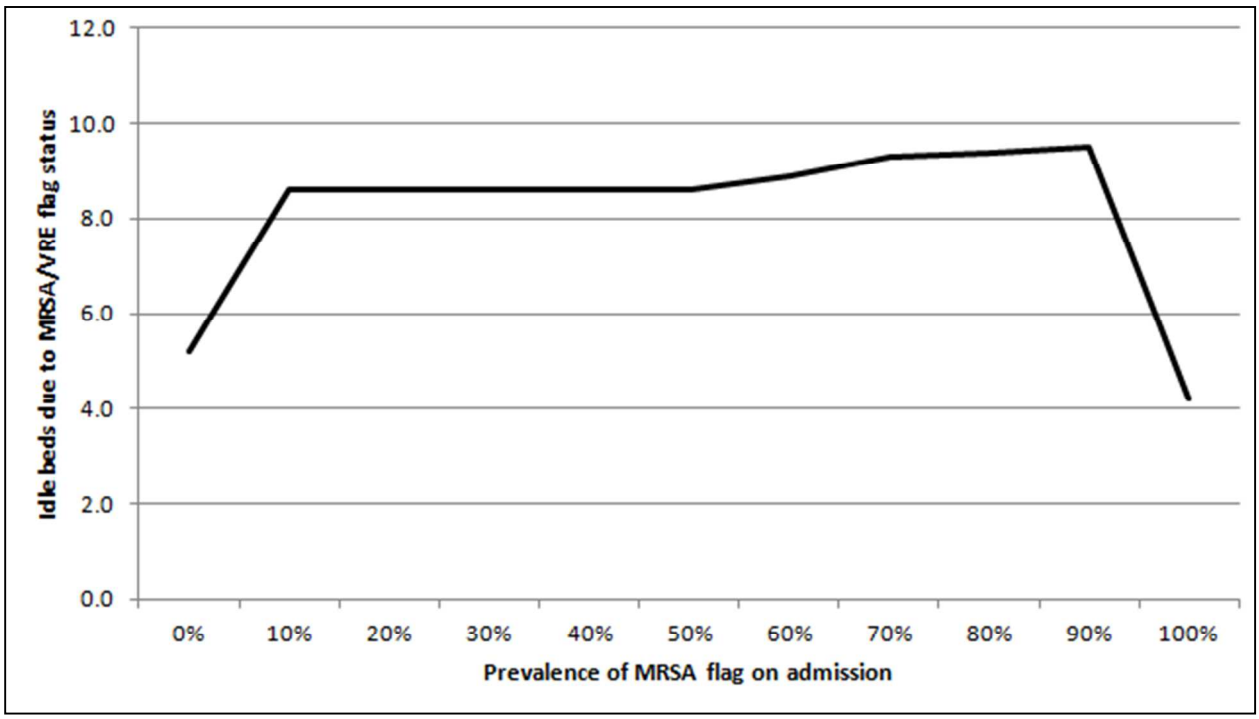

Figure 9S. Idle beds by varying prevalence of MRSA flag on admission. The prevalence of MRSA flag on admission as an input was varied from extremes of 0% to 100%, while holding the prevalence of VRE and both MRSA and VRE combined at 0%. At the extreme prevalence's of 0% and 100%, all patients match on flag status and therefore all remaining idle beds are due solely to gender mismatch.

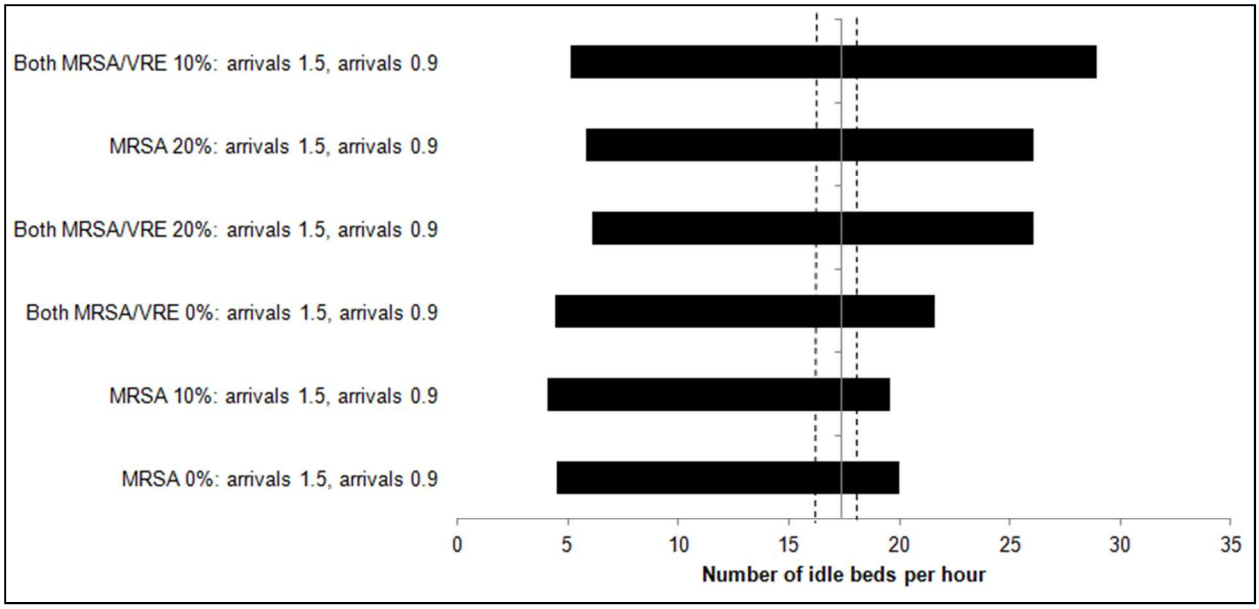

Figure 10S. Results of multi-way sensitivity analysis around total idle beds. Shown are the effects of altering the inputs of prevalence of MRSA and both MRSA/VRE flag on admission in combination with arrivals on the number of total idle beds per hour model output. The solid vertical line indicates the mean base case value (15.0 total idle beds) across ten 1-year runs. On either side of this line are two dotted lines indicating the range across the ten 1-year base case runs. Each horizontal bar represents a single input parameter being altered, with the length of each bar representing the range of idle beds over the specified values for each combination of input parameters modified.

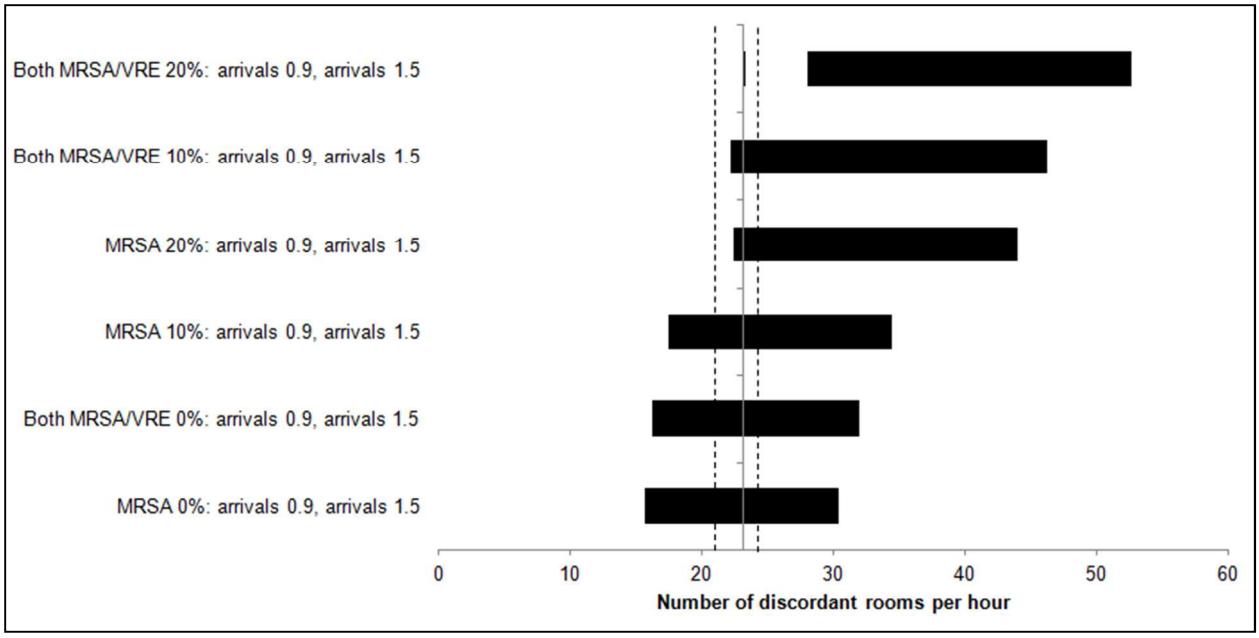

Figure 11S. Results of multi-way sensitivity analysis around rooms with discordant colonization. Shown are the effects of altering the inputs of prevalence of MRSA and both MRSA/VRE flag on admission in combination with arrivals on the number of rooms with discordant colonization per hour model output. The solid vertical line indicates the mean base case value (23.1 rooms with discordant colonization per hour) across ten 1-year runs. On either side of this line are two dotted lines indicating the range across the ten 1-year base case runs. Each horizontal bar represents a single input parameter being altered, with the length of each bar representing the range of idle beds over the specified values for each combination of input parameters modified.

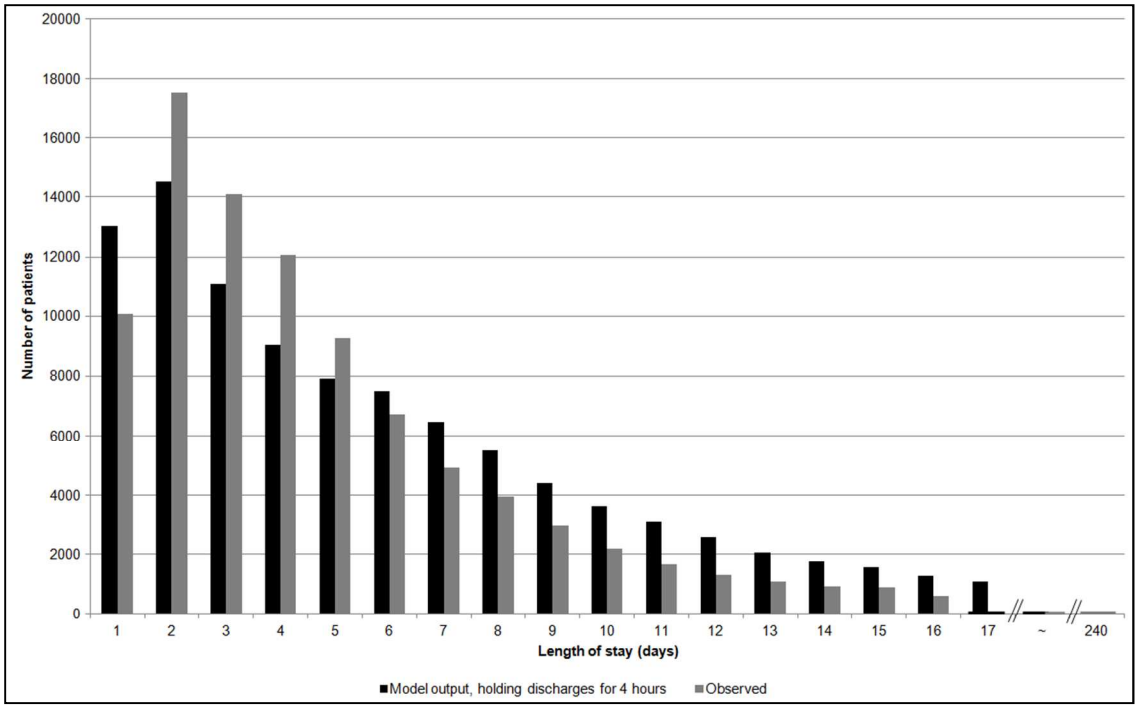

Figure 12S. Distribution of length of stay blocking discharges for initial 4 hours. The observed distribution of length of stay in days compared to that of the model outcome of a randomly selected single simulation run, blocking discharges within the initial 4 hours of patient length of stay.

Table 1S. Observed and model outcomes from base case and blocking discharges within initial 4 hours of patient length of stay			
Outcome	**Observed**	**Base case**	**Base case, blocking discharges for initial 4 hours**
Time to bed arrival (hours)	6.7	6.3	7.6
Length of stay (days)	3.3	3.0	3.5
Patient-bed acuity mismatches			
Low seeking high	-	0.7	1.1
High seeking low	-	9.5	13.8
Occupancy	91%	87%	90%
Idle beds			
Total	15.1	15.0	11.7
Due to MRSA/VRE flag	11.7	11.1	8.9
Due to staffing	3.4	3.9	2.9
Acuity-related transfers	27.2	23.2	20.8
Rooms with discordant colonization	N/A	23.1	25.2
Incident cases MRSA due to discordant colonization per year	N/A	48.2	51.5
Incident cases VRE due to discordant colonization per year	N/A	74.3	77.5

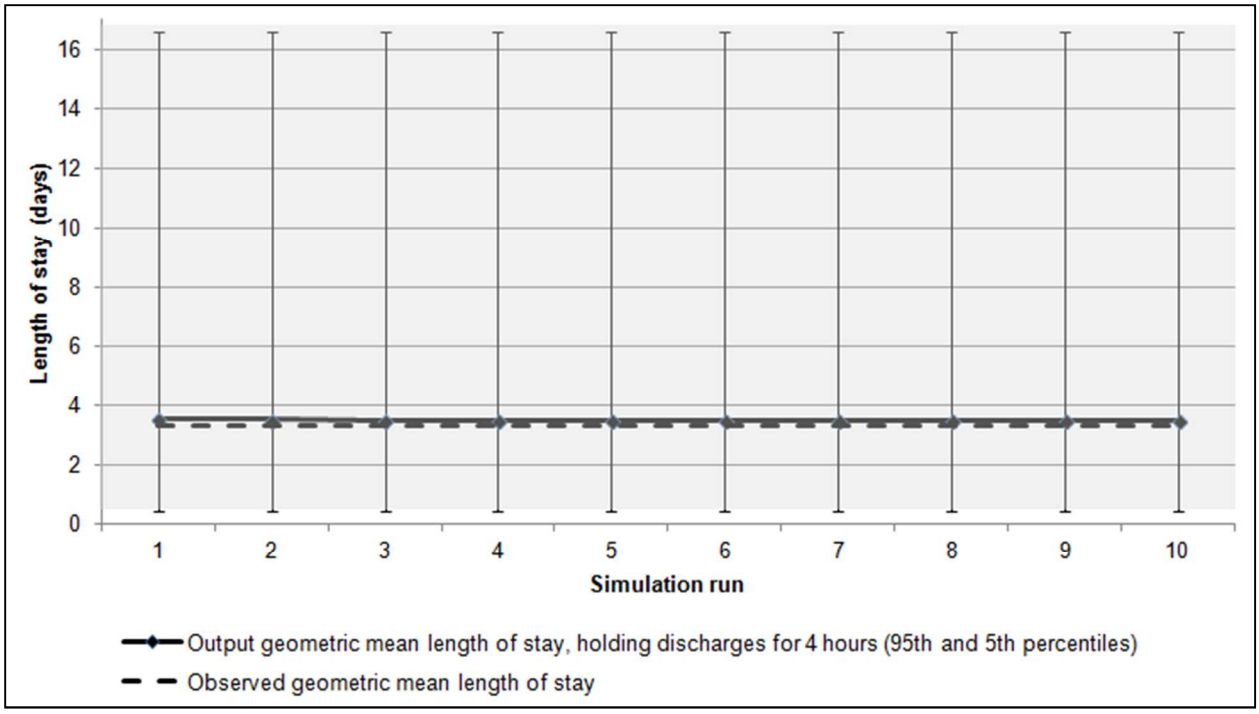

Figure 13S: Length of stay blocking discharge for initial 4 hours. The observed geometric mean length of stay (3.3 days) is compared to the geometric mean length of stay model outcome across ten individual simulation runs blocking discharges within the initial 4 hours of patient length of stay, along with the 90% coverage interval for the simulated data within each run. The 90% coverage interval (0.4-16.2 days) around the observed mean length of stay is shaded.

Section A. Model Programming

The model was coded in Python 2.7 (Python Software Foundation, Beaverton, OR) and included both a console version (run on both Windows and Linux) as well as a Graphical User Interface (GUI) version, run on Windows, and developed using the wxpython package. The GUI provides a real time visualization of the hospital structure and patient movement. We chose to use open-source software to build the model in-house, rather than employing commercial packages for cost, flexibility, and dissemination considerations. Employing a developer as part of the research team allowed for direct access to model development, which is an iterative process [19]. The model was run for a total of ten year-long runs with one-hour time-steps (8,760 time-steps annually). The model was initialized with no inpatients and was run for a period of one year in order to seed the model prior to tracking outputs. Over a single year, roughly 47,600 incident patients pass through the model. The processing time for a batch of ten 1-year runs was approximately 20 minutes.

Section B. Acuity transition matrix

The acuity transition matrix was created using patient location data from the database. A matrix was created by breaking each patient's length of stay into one-hour strata consisting a series of the number of patients transitioning from a given acuity to any other acuity after every hour in that acuity. The relative frequencies (i.e., transition probabilities) were calculated using the date and time stamps and acuity associated with each consecutive non-virtual bed location at the patient level.

To account for patients in the database with extreme lengths of stay (and therefore extreme hours for acuity changes where observations are sparse), acuity change thresholds are imposed, preventing the extreme tail end of acuity changes for each current acuity. To determine the threshold values for transitions from each acuity, the transition with the earliest last observation was defined (T_{last}) as the threshold time. Due to sparse observations at the tail end of each acuity, the relative frequencies observed at T_{last} through $T_{sum\ last\ 10\ hours}$ were summed, with this value equal to the relative frequency for all modeled transitions after T_{last}.