**Harris Model Project Plan**

1. ADT
   1. Implement admissions (ward vs. ICU)
   2. Implement LOS determination (ward, ICU, both)
   3. Implement transfer from ICU to ward (not opposite)
   4. Implement final discharge (discharge vs. death)
   5. Review and calibrate data output: patient flow, LOS, mortality
2. Hospital Design
   1. Implement all hospital ward rooms (one unit, size: 85 beds)
   2. Implement ICU rooms (one unit, size: 15 beds)
   3. Implement process for determining if patient is on CP
      1. If Patient is in the I state
      2. Will determine if we want a check while in the C state
   4. Implement all categories of HCW (MD, RN, PT, RT, OT)
   5. Determine and specify appropriate implementation parameters
      1. HCW assignments?
      2. HCW Visit frequencies
      3. HCW/patient ratios (to determine number of each)
      4. Fraction of patients requiring PT/OT/RT
3. Disease Model
   1. Implement a disease model for MRSA
   2. Implement states for S, C, I, and R
   3. Implement admission process to determine if S or I on admission
   4. Implement transitions between states
      1. S to C
      2. C to I
      3. I to R
   5. Implement probability check on discharge
      1. Probability of Death by MRSA if in state I
      2. Probability of Death by something else if in any other state
      3. Related to 1.d. above
4. HCW Visits
   1. Implement HCW visit event process
   2. Implement process for initiating each event (based on 2.d.ii above)
   3. Implement process for checking Patient and HCW MRSA states
      1. Implement skip for event if Patient and HCW are not colonized
   4. Implement probability checks at different steps during the event
      1. Pre-visit check for HCW HH
      2. Pre-visit check for HCW Gown & Glove use (if on CP)
      3. Main check for transfer (to HCW or to Patient)
         1. In presence or absence of Gown & Gloves
      4. Post-visit check for HCW HH

**Model Parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Notes & References** |
| ICU bed count | 15 | None |
| Non-ICU bed count | 85 | None |
| ICU admission fraction | 10% [5-15%] | 10.1097/00003246-198209000-00002 10.1097/CCM.0b013e31827c086f 10.1007/s00134-023-07031-w |
| Pr(Transferring from ICU to ward) | 78% | Molly? |
| Pr(All-cause ICU mortality) | 7% [7-10%] | MIMIC-IV data 10.1186/s12911-024-02807-6 10.1136/bmjopen-2024-090011 |
| Pr(MRSA ICU mortality) | 30% [29-32%] | Mostly bacteremia & pneumonia 10.1186/cc9654 10.1086/345476 10.1016/j.ijantimicag.2011.05.013 10.1016/j.jcrc.2010.05.033 |
| Pr(All-cause hospital mortality) | 3% [2-5%] | 10.1016/j.ajmo.2022.100028 10.1097/00003246-198209000-00002 |
| Pr(MRSA hospital mortality) | 5% | Includes BSI, PNA, SSI, SSTI 10.1001/archinte.162.19.2229 [http://www.hcup-us.ahrq.gov/reports/statbriefs/sb35.pdf](https://hcup-us.ahrq.gov/reports/statbriefs/sb35.pdf) 10.1038/s41598-020-60825-6 10.1016/j.jhin.2022.07.004 |
| LOS, general ward | 4.7d [4.5-5.0] | [https://www.ncbi.nlm.nih.gov/books/ NBK574438/](https://www.ncbi.nlm.nih.gov/books/NBK574438/) [www.hcup-us.ahrq.gov/reports/statbriefs/sb246-Geographic-Variation-Hospital-Stays.pdf](https://hcup-us.ahrq.gov/reports/statbriefs/sb246-Geographic-Variation-Hospital-Stays.pdf) [https://www.definitivehc.com/resources/ healthcare-insights/average-length-of-stay-by-state](https://www.definitivehc.com/resources/healthcare-insights/average-length-of-stay-by-state) |
| LOS, ICU | 4.3d [3.8-4.5] | 10.1097/CCE.0000000000001001 10.1097/CCM.0b013e31820eabab 10.1097/CCM.0000000000001480 |
| LOS in hospital after ICU stay | 5.6d | 10.1097/CCM.0b013e31820eabab |
| % Admissions with MRSA infection | 1.0% [0.8-1.0] | [www.hcup-us.ahrq.gov/reports/statbriefs/sb315-overview-MRSA-2016-2021.pdf](http://www.hcup-us.ahrq.gov/reports/statbriefs/sb315-overview-MRSA-2016-2021.pdf) |
| % Patients who acquire MRSA | 1.0% [1.0-1.2] 2.3/1000pd | 10.1093/cid/ciy507 10.1016/j.jinf.2019.10.001 |
| % Patients who get MRSA HAI | 0.4% [0.2-0.5] 0.04-0.08/1000pd | [www.hcup-us.ahrq.gov/reports/statbriefs/sb315-overview-MRSA-2016-2021.pdf](http://www.hcup-us.ahrq.gov/reports/statbriefs/sb315-overview-MRSA-2016-2021.pdf) 10.1371/journal.pone.0235754 |
| % MRSA colonized that progress | 15% [10-15] | 10.1086/345955 10.1186/1471-2334-13-491 |
| Pr(Use of G&G|CP) – ICU | 70% [50-90] | 10.1086/668775 10.1093/cid/ciac519 10.1086/498906 |
| Pr(Use of G&G|CP) – Ward | 55% [30-80] | 10.1086/668775 10.1093/cid/ciac519 10.1086/498906 |
| Pr(pre-HH) – ICU | Variable by role | Data collection |
| Pr(pre-HH) – Ward | Variable by role | Data collection |
| Pr(post-HH) – ICU | Variable by role | Data collection |
| Pr(post-HH) – Ward | Variable by role | Data collection |
| Effectiveness of HH | 0.95 [0.85-0.99] | 10.1186/s13756-021-01049-9 |
| Effectiveness of G&G | 0.5 [0.5-0.7] | 10.1080/24725579.2018.1431739 |
| Pr(Transmission from Pt to HCW) | 0.04 [0.03-0.05] | 10.1080/24725579.2018.1431739 |
| Pr(Tansmission from HCW to Pt) | 0.04 [0.03-0.05] | 10.1080/24725579.2018.1431739 |

* ICU Bed Count: 15
* Non-ICU Bed Count: 85
* ICU Admission fraction: 15%?
  + Probability of transferring to regular ward (78%)
  + Given transferring, time-to-transfer distribution
* Length of Stay distributions (ICU admit/Non-ICU admit): From pre-existing work
* MRSA attributable LOS
* Importation Fraction
* Staffing Counts (ICU-specific? Or free ranging?)
  + RT
  + PT
  + OT
  + Nurse
  + Physician
* Shift duration: 12h
* Differential staffing during second shift?
* From MIND model:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | Nurses | CNA | Dr | Pharmacist | PT | Student nurses |
| ICU | 8 | NA | 4 full time | 2 day shift | 5 weekdays  1 weekends  Day shift only |  |
| Telemetry | 6 | NA | 3 day shift | 1 day shift |
| 2 East (med) | 8 | 3 | 3 day shift | 1 day shift |
| 3 West (surg) | 8 | NA | 3 day shift | 1 day shift |

* Room Visit Model
  + HCW assigned to specific ward time makes random selection from patients on that ward time
  + HCW assigned to float across all wards makes random selection from patients in the facility
  + Visit Types / Durations
    - We have data for visit durations in CP vs non-CP rooms, too

3. Long

* + - * Gamma(3.0, 1.8)
    - 2. Medium
      * Gamma(5.5, 1.2)
    - 1. Short
      * Gamma(30.1, 0.1)
  + Time between visits by HCW type
    - Nurse
      * Gamma(0.54, 55.1)
    - Physician
      * Gamma(0.52, 90.7)
    - Pt
      * Gamma(0.52, 61.7)
    - OT, RT unknown
  + Frequency of visit type (1/2/3) by ward and HCW Type
    - ICU
      * Nurse 33/42/25
      * Physician 34/42/24
      * PT 30/53/17
    - Ward (med/surg)
      * Nurse (22/28/50)/(23/30/47)
      * Physician (17/28/55) / (36/23/41)
      * PT (23/46/31) / (28/40/32)
  + Number of hand hygiene events per visit type (no major differences by HCW role or unit, is this true?)
    - 1: none
    - 2: none
    - 3: Poisson(2.5)
* Disease Model:
  + ICU Importation Rate
    - Colonized
      * Probability of progression
      * If progression, time to progression distribution (bounded by total LOS?)
    - Infected
      * Probability of death
  + Non-ICU Importation Rate
    - Colonized
      * Probability of progression
      * If progression, time to progression distribution (bounded by total LOS?)
    - Infected
      * Probability of death
  + Newly Colonized
    - Probability of progression
    - If progression, time to progression
  + Newly progressed
  + Calibration
    - MRSA Prevalence (% of patients that are infected during stay)
      * 0.6% (MIND/INTERACT/GM data)
  + Transmission
    - Probability of contaminated HCW colonizing patient in visit types 1/2/3
    - Probability of colonized patient contaminating HCW in visit types 1/2/3
    - Probability of HCW loss of contamination during HH adherence
  + Clinical Detection, Treatment, Isolation?

**Model Output Verification**

Model run time: 1 year?

1. ADT

For each admission instance: admit location (ward/ICU), discharge location (ward/ICU), admit time, discharge time, transfer time (to ICU, if any)

Summary stats: total admissions, total admissions to ward, total admissions to ICU, % admissions to ward/ICU, total discharges from ward, total discharges from ICU, % discharges from ward/ICU, total transfers to ICU, % admissions with transfer to ICU, average LOS, average LOS on ICU, frequency distribution of LOS

1. HCW Visits

For every triggered HCW visit: HCW identifier, HCW type, patient ID, visit time

Summary stats:

Individual stats: average total visits per HCW per shift (by HCW type), average daily visits per patient per HCW per shift (by HCW type), average number of unique patients visited per shift per HCW (by HCW type), average time between visits per HCW per shift (by type), average number of HCW visits per day per patient (total and by HCW type), average time between visits by HCW per patient (total and by HCW type), average number of unique HCW visited by patients per day

1. Visit Events

TBD