CENTER FOR HEALTHCARE ENGINEERING & PATIENT SAFETY
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Removing Bottlenecks in The Newborn Screening Process in Michigan

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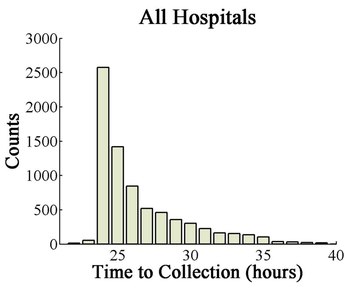
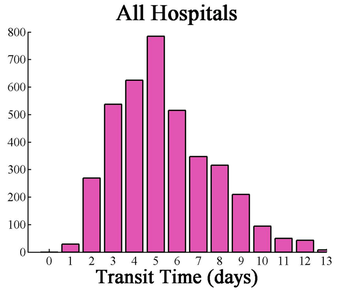
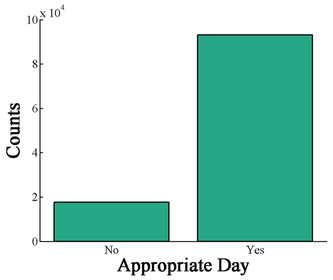
Aim 1. Identifying Bottlenecks

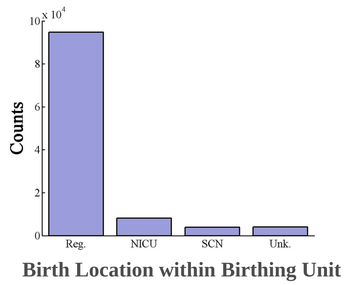
- Data has been collected from the Michigan NBS Program and Vital Records, which contains information on over 100,000 births across 84 birthing hospitals from April 1, 2014 to March 31, 2015.
- Generalized linear mixed-effects model† will be used to identify which factors contribute significantly to whether a test is returning within a 96 hour window after birth.
- Birthing unit is considered as a random effect, since data within a birthing unit are likely correlated.
- Fixed effects considered:
  - Average time to collect specimen after birth by birthing unit
  - Average time to transport specimen by birthing unit
  - Volume of birthing unit
  - Individual time to collect specimen after birth relative to hospital average.
  - Time to transport specimen after birth
  - Day of the week that specimen was collected
- The model will be constructed using SPSS to determine factors (fixed and random effects) which are statistically significant in determining whether or not a test is returned on time. Because of the amount of data, significance will be considered an alpha level of 0.01.

† Specifically, we use logit link function with a binomial distribution.

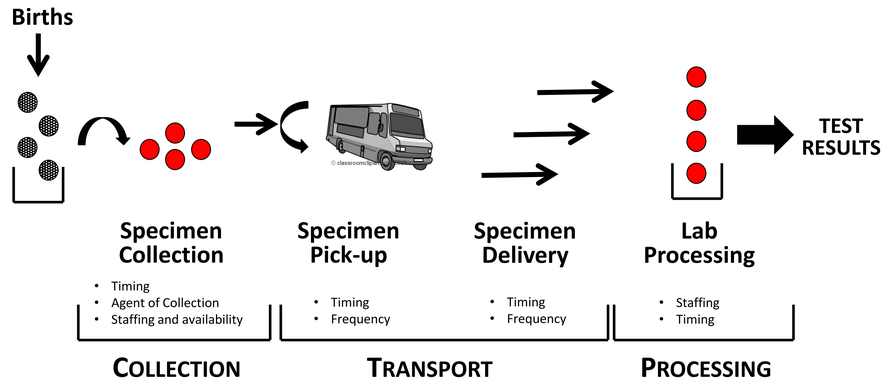








The Newborn Screening Process (NBS)



- Newborn screening (NBS) is the process of testing newborns for disorders that are hidden at birth.
- The NBS Process consists of four main phases:
  1. Collecting an NBS specimen after birth,
  2. Transporting the specimen to the lab,
  3. Processing the specimen at the lab, and
  4. Returning the lab results.
- Test results should be returned as early as possible since prognosis for many diseases can worsen with time.
- It is currently unknown how each phase, and its attributes (e.g. collection day), contributes to the time between birth and returning lab results.
- With the NBS process poorly described, it remains unclear how resources should be allocated to improve efficiency of the testing process.

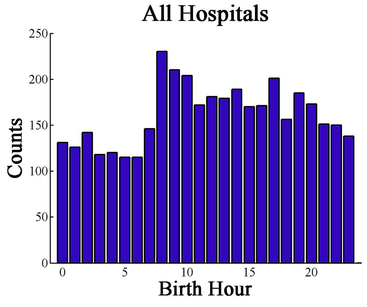
Specific Aims

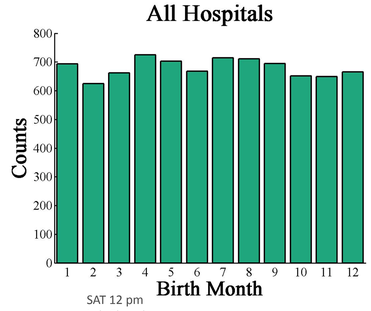
1. **Identify those attributes/phases of the NBS process that most greatly determine whether NBS results are available within 96 hours of birth.**
2. **Analyze the tradeoff in terms of time, cost, and lives-saved between strategies that either (a) decrease collection time, (b) decrease transport time, or (c) expand capacity at state public health laboratories.**

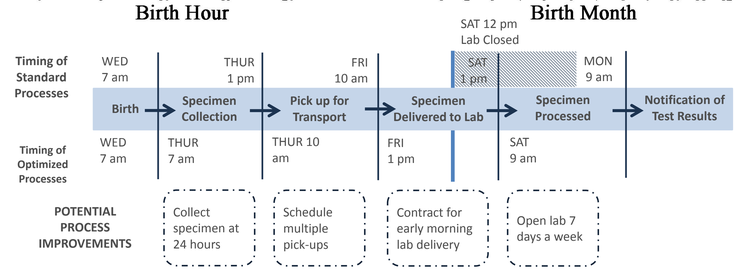
Aim 2. Comparing Strategies

- Data has been collected from the University of Michigan Data Warehouse from June 1, 2014 to May 1, 2015.
- A scenario analysis will be performed d using discrete-event simulation models built in Matlab.
- Each of the four phases of the NBS process will be modeled as a time-dependent stochastic process.
- Data will be used to propose various models of the phases of the NBS process and statistical tests will be conducted to identify appropriate models and their associated parameters.
- Using these data-driven models of the NBS process, we will simulate the NBS process and modify certain aspects of the NBS process to identify how these changes impact whether or not a test is returned on an appropriate day.

Below: Births will be modeled as a time-dependent stochastic process. As seen below, it will depend on the hour of birth.







An example of an NBS Process from the perspective of the mother.

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