

Partnering with a University Data Science Department to Develop Innovative Tools for the Analysis and Reporting of NBS Data

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Background



Limited
technical
resources

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Manual and
time-intensive
procedures

September 2016: A Connection Is Made

- UVA M.S. Data Science – Capstone Project
 - 8-month assignment
 - Students apply knowledge base to help solve real-life data science problems
- Lab director learned of opportunity through an acquaintance at the UVA Data Science Institute

- Matched with 2 students

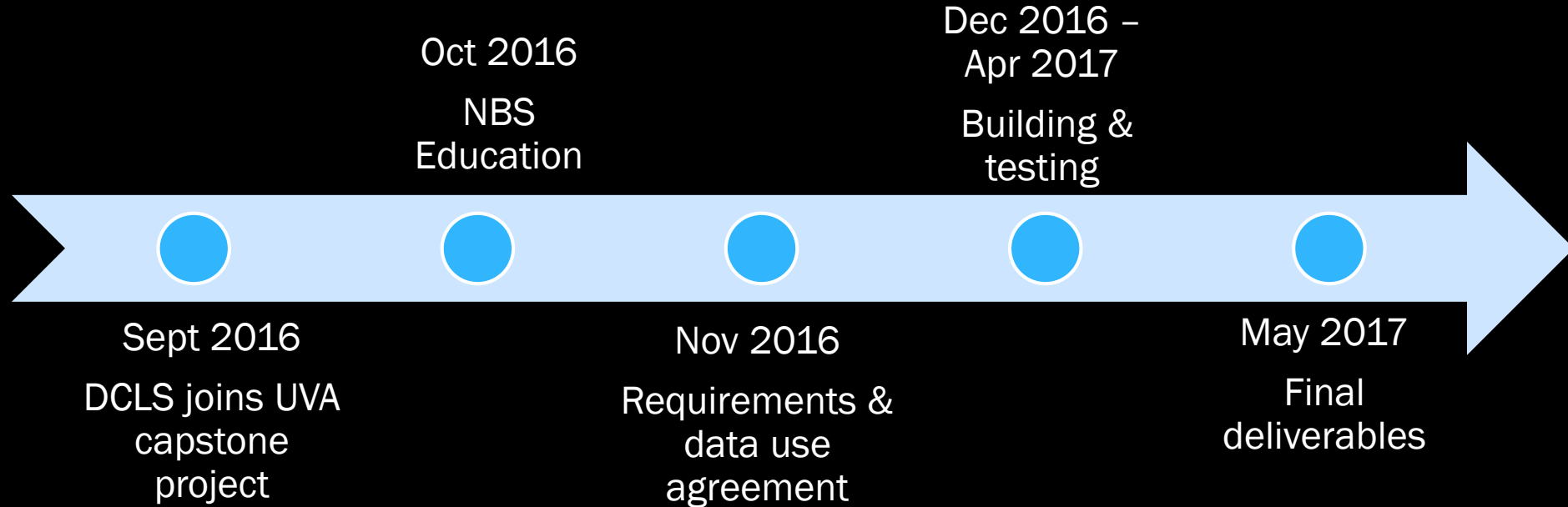


Hampton Leonard, M.S.



Christopher Patrick, M.S.

Project Timeline

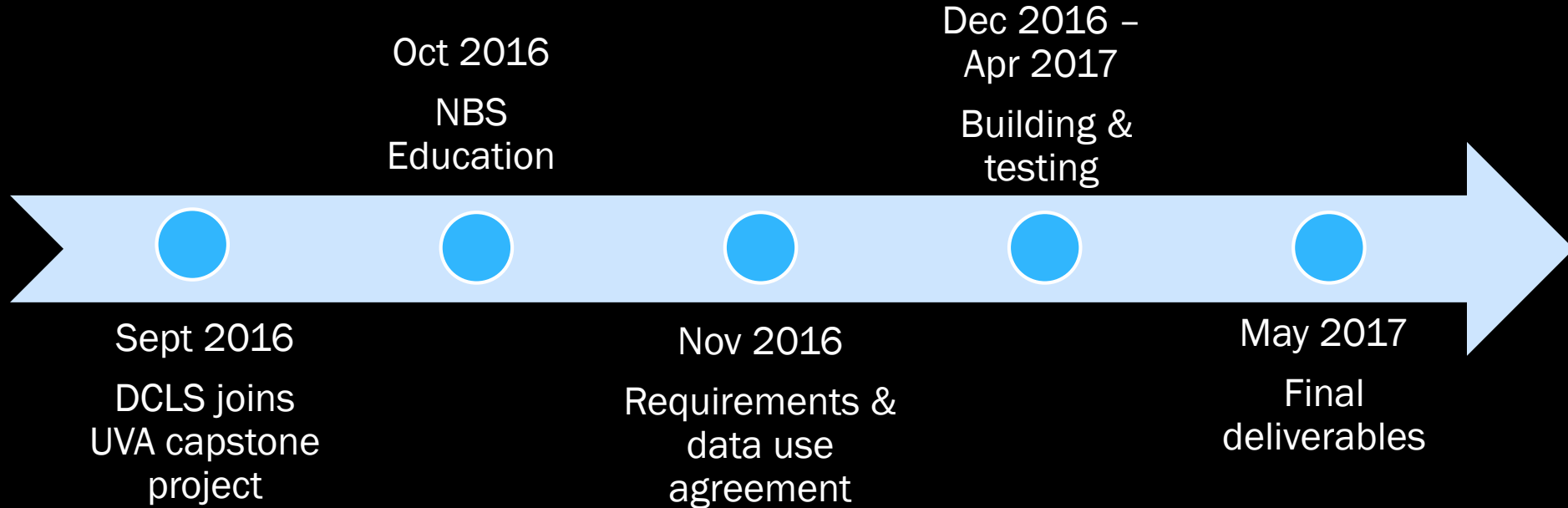


Objectives

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1. Automate the newborn screening hospital report card
2. Automate the NewSTEPs360 monthly reporting
3. Visualize disease distribution in Virginia
4. Explore false positive statistics

Project Timeline



Methods

Methods

- R Programming



- What is R?
 - Statistical software and programming language
- How is R superior to Excel?
 - Automation and Reproducibility
 - Ability to handle BIG data
 - Superior visualizations
 - IT'S FREE!

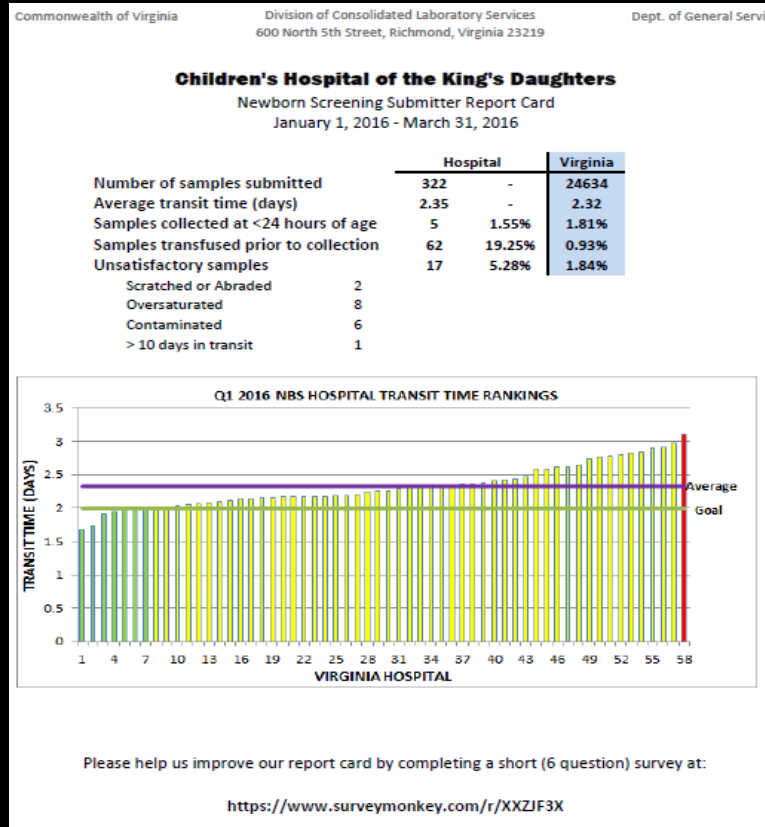
Results

What Virginia Gained From One Academic Year Of A University Partnership

Automated Hospital Report Card

Hospital Report Card Process: Before

- Used Excel for analysis and template design
- Relied on snail mail
- Week-long process

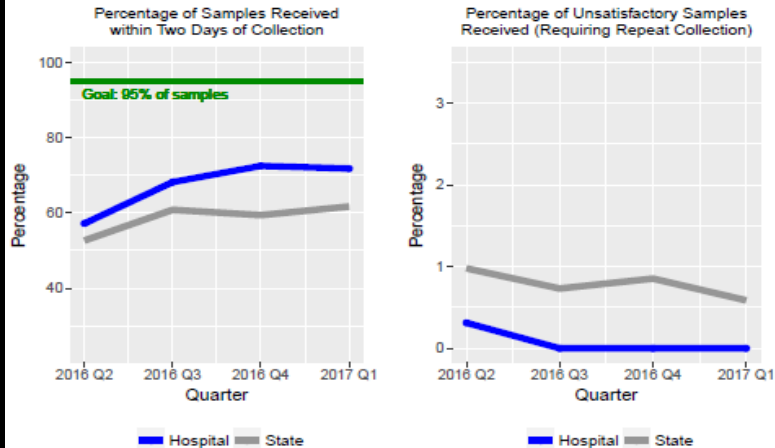


Hospital Report Card: After

Augusta Health

January 1, 2017 - March 31, 2017

	Hospital	Hospital Rank	Virginia
Number of samples submitted	273		22,869
Average transit time	1.61 days	12th of 59	1.93 days
Samples received within 2 days of collection (GOAL: 95%)	196	71.79%	61.7%
Samples collected at < 24 hours of age	0	0%	1.49%
Samples transfused prior to collection	1	0.37%	0.81%
Unsatisfactory samples	0	0%	0.59%



Please share this with the staff

Extract Raw Data From LIMS



Run Scripts

- <10 minutes to generate
- Improved statistics
- Individualized comments

Diagnosed Cases through Newborn Screening at Augusta Health

This report is a summary of disorders affecting babies born at your facility. These babies benefited from timely diagnosis and treatment due to your vigilance in Newborn Screening. Please share this with the staff to remind them that Newborn Screening Saves Lives!

Diagnosis Date Range: January 1, 2017 - March 31, 2017

Diagnosis	Count	Description
Hemoglobinopathy Carrier	2	Carriers of the hemoglobin traits are typically asymptomatic. Hemoglobinopathies is a collective term for a group of autosomal recessive disorders characterized by abnormal hemoglobins without the presence of S (Hb S). These disorders include Thalassemias and other hemoglobinopathies in which Hb A is not present or reduced in combination with another variant hemoglobin. The most common examples include Thalassemia major (F), Hb C disease, Hb C beta Thalassemia, Hb D disease, Hb E disease, and Variant (FV). Depending on the hemoglobinopathy, mild to severe anemia may be present with complications in the spleen or liver.
Sickle Cell Disease Carrier	2	Carriers of the Sickle cell disease traits are typically asymptomatic. Sickle cell disease (SCD) is a collective term for a group of autosomal recessive disorders characterized by the predominance of hemoglobin S (Hb S). These disorders include sickle cell anemia (SS), the sickle beta thalassemia syndromes, and hemoglobinopathies in which Hb S is present in combination with another variant hemoglobin. The most common examples include hemoglobin SC disease, hemoglobin SD disease, and hemoglobin SE disease. Hemolytic anemia may be related to repeat cycles of sickling and unsickling, which interact to produce irreversible red cell membrane changes, red cell dehydration, and erythrocyte destruction.

Hospital Report Card: After

- Diagnoses- number of cases and a narrative
- Shows impact of NBS on babies born in their hospitals

Hospital Report Card: Additional Features

- Automatically delivered to all individual hospital contacts in <10 seconds
 - Ability to customize the body of the email
- 4 additional ancillary reports for internal use
 - Hospital Summary
 - State Summary
 - Diagnosis Summary
 - Transit Time Outliers

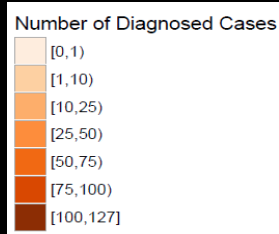
Automated NewSTEPS360 Quality Indicator reporting

NewSTEPs Quality Indicator Reporting

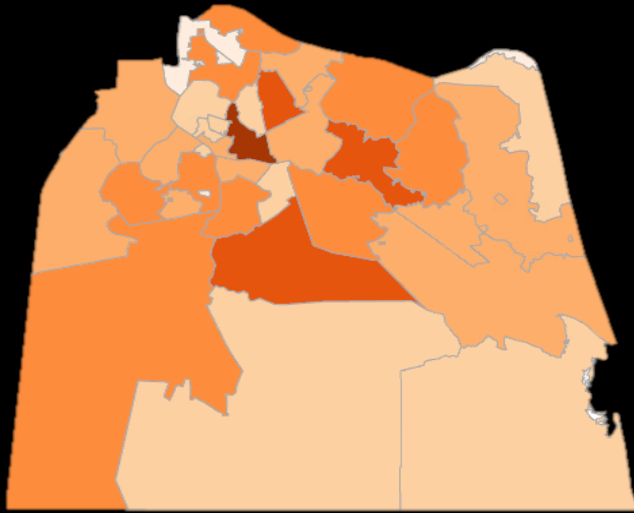
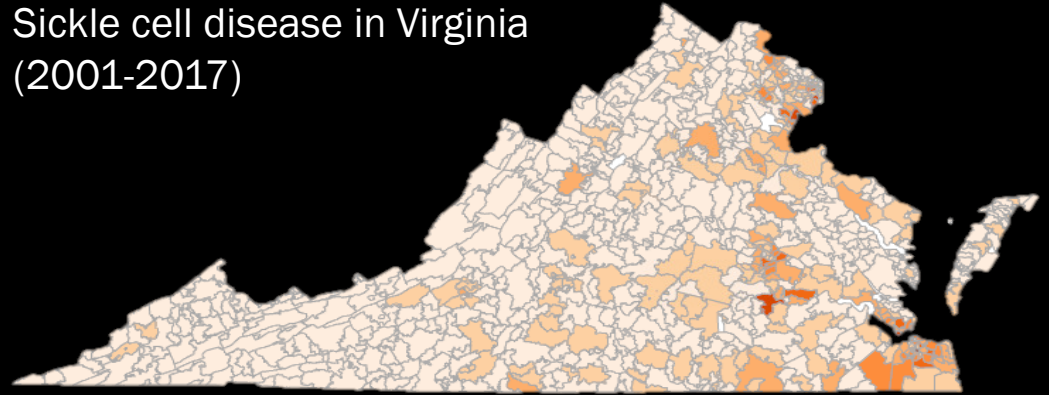
- 131 quality indicators
- Calculated and written to a .csv file in <5 seconds
- .csv allows for direct importing into the NewSTEPs data repository

5c) Time from specimen receipt at lab
Description
5c.i - For Time Critical Disorders: Dried blood spot specimens
Same day as receipt at lab (Day 0)
Day after receipt at lab (Day 1)
Day 2 after receipt at lab (Day 2)
Day 3 after receipt at lab (Day 3)
Day 4 after receipt at lab (Day 4)
Day 5 after receipt at lab (Day 5)
Day 6 after receipt at lab (Day 6)
Greater than or equal to Day 7 after receipt at lab (>=Day 7)
Time elapsed unknown
5c.ii - For Non-Time Critical Disorders: Dried blood spot specimens
Same day as receipt at lab (Day 0)
Day after receipt at lab (Day 1)
Day 2 after receipt at lab (Day 2)
Day 3 after receipt at lab (Day 3)
Day 4 after receipt at lab (Day 4)
Day 5 after receipt at lab (Day 5)
Day 6 after receipt at lab (Day 6)
Greater than or equal to Day 7 after receipt at lab (>=Day 7)
Time elapsed unknown
5c.iii - Normal and Out-of-Range Results for All Disorders from Dried Blood Spot Specimens
Same day as receipt at lab (Day 0)
Day after receipt at lab (Day 1)
Day 2 after receipt at lab (Day 2)
Day 3 after receipt at lab (Day 3)

Visual Mapping of Diseases



Sickle cell disease in Virginia (2001-2017)



- Ability to view disease distribution at the state and county level

Automated False Positive Statistical Reports

False Positive Statistics

IRT: Test Data

# of Critical Samples Where No Disease Is Present	180
% of Critical Samples Where No Disease Is Present (Denominator: All Samples)	0.01
% of Critical of Samples Where No Disease Is Present (Denominator: All Abnormal Samples)	77.92

- Analyze positive sample results compared to disease state
- Ability to filter by date range and certain infant factors (such as low birth weight or TPN feeding)

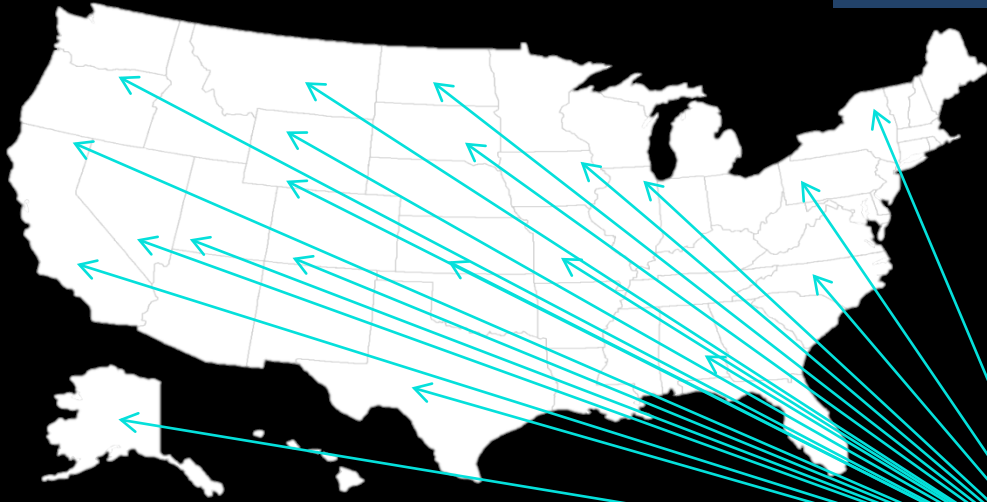
So, why should you partner with a university?

- ✓ **FREE!**
- ✓ **Skilled**
- ✓ **Technologically equipped**
- ✓ **They want to partner with you!**

Get out and make connections!

- 235 data science colleges across the country
- Be proactive!

“Be willing to get creative and find ways to do things when you have limited resources” – Willie Andrews



THANK YOU

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