Grant Final Report

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Improving Safety and Quality with Integrated Technology

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Abstract

Purpose: Discontinuities in clinical information systems pose a large problem for everyday clinical practice. Although care for patients spans outpatient and inpatient settings, clinical information systems, until now, focus on either outpatient or inpatient but not both. We demonstrated the value of an integrated outpatient and inpatient health information system to improve quality of health care and patient safety.

Scope: Pregnant women inevitably transition across inpatient and outpatient settings in a matter of months, making this an ideal situation to test whether integration can make a difference. GBS is a leading infectious cause of neonatal death and serious morbidity in the newborn, affecting up to 1.6 million US infants each year. The majority of infections are acquired through vertical transmission from a colonized mother to her newborn during labor and delivery. GBS colonization of the maternal genital tract is common with up to 40% of pregnant women being GBS carriers. Transmission is preventable simply with administration of penicillin to the mother during labor. Because of this, the CDC recommends universal GBS screening of all pregnant women. Without an integrated data system, the issue of GBS status poses a real clinical dilemma. When a patient arrives in labor at term, GBS status is one among many important outpatient data points for which the clinician searches. If the status is unknown, the clinician does not know if the test was not performed or if it was performed but results are not accessible to them. Hypothesis: An integrated outpatient and inpatient health information system will improve patient safety and quality of health care.

Methods: Three specific aims were completed in this project:

I. Demonstrated the value of an integrated outpatient and inpatient health information technology system to improve quality of care and safety for women and infants, using group B Streptococcus (GBS) prevention as the test case.

II. Demonstrated the value of an outpatient alert system to increase GBS screening

III. Performed a policy analysis comparing the costs and implications for GBS screening according to the US, Canadian, and UK policy to inform health care delivery and obstetric safety discussions.

Results: This project demonstrated that an integrated outpatient and inpatient data system has considerable value to improving patient safety. In particular, it demonstrated value in the comprehensiveness of records. In general, there was improvement in timely access to time critical information, and decision support to promote safe care practices relating to GBS screening and treatment. Additionally, the breadth of data allowed us to perform a policy analysis comparing Canadian, US, and UK screening and management policies for GBS and the costs relating to each. Such data are very informative to the discussion surrounding the safe and cost efficient redesign of the US health care delivery system.

Key Words: health information technology, medical record systems, computerized, pregnancy, pregnancy complications, patient safety, streptococcal infections, pregnancy complications, infectious, mass screening, hospital information systems

Final Report

Purpose

The goal of this project was to demonstrate the value of an integrated outpatient and inpatient health information system to improve quality of health care and patient safety using data from a high-volume labor and delivery unit in a large, busy, fast-paced university hospital in the United States. We chose a frequent and significant clinical situation to test the value of an integrated system – group B streptococcus (GBS). GBS is a leading infectious cause of neonatal death and serious morbidity in the newborn. Without an integrated data system, the issue of GBS status poses a real clinical dilemma.

Scope

Factors that affect the health of patients span both outpatient and inpatient arenas. Clinical information systems, particularly electronic ones, have been, until now, designed specifically for either outpatient or inpatient settings, but not both. Discontinuity between outpatient and inpatient systems poses a huge problem for everyday clinical practice. There are many examples of conditions that cause patients to transition across outpatient and inpatient settings for example: diabetes, asthma, and congestive heart disease. Pregnancy is an ideal situation to test the hypothesis that integration makes a difference, since 4 million women annually inevitably flow across outpatient and inpatient settings in a matter of months.

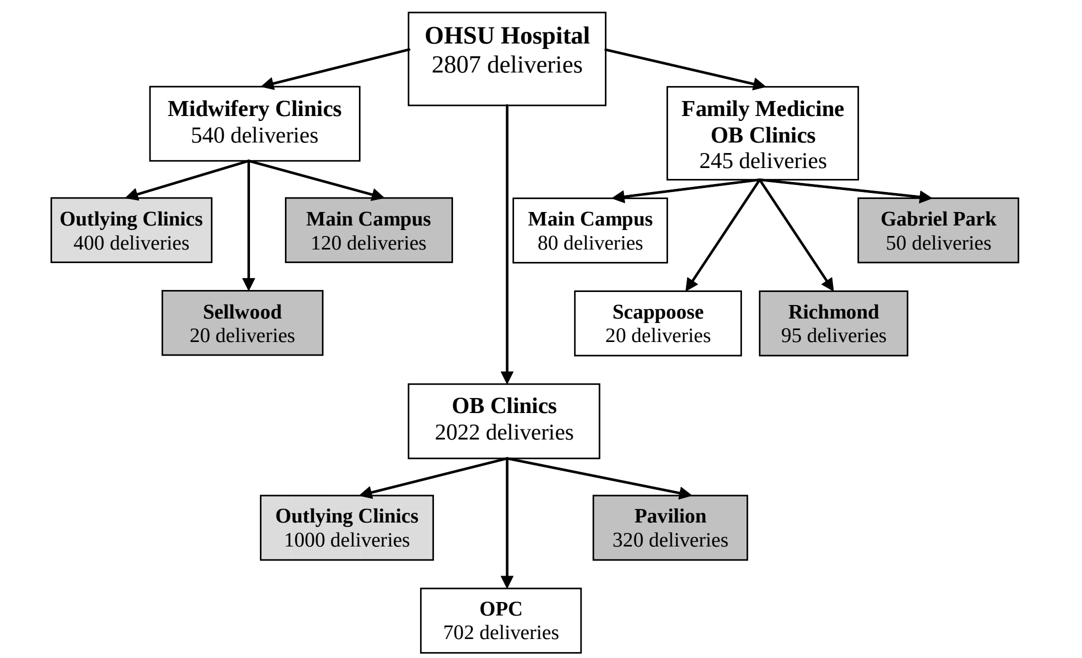
GBS is a leading infectious cause of neonatal death and serious morbidity in the newborn. The majority of infections are acquired through vertical transmission from a colonized mother to her newborn during labor and delivery. GBS colonization of the maternal genital tract is common, with up to 40% of pregnant women being GBS carriers. Transmission is preventable simply with administration of penicillin to the mother during labor. Because of this, the CDC recommends universal GBS screening of all pregnant women. Colonization can be chronic or transient, for that reason, the CDC recommends screening close to the time of delivery at 35-37 weeks gestational age. This critical timing poses a challenge to traditional systems to transmit results to the inpatient unit before delivery.

Without an integrated data system, the issue of GBS status poses a real clinical dilemma. When a patient arrives in labor at term, GBS status is one among many important outpatient data points for which the clinician searches. If the status is unknown, the clinician does not know if the test was not performed or if it was performed but results are not accessible to them. Regardless of the cause of the missing information, the clinician is then faced with the decision of whether to test again if time permits (need at least 48 hours for results), treat unnecessarily, or risk no treatment with the 20-40% chance that patients may be GBS positive.

Although the adoption and use of HIT has certainly resulted in reductions in medical errors, particularly surrounding physician order entry (Teich, et al., 1999), practicing clinicians and recent reports in the medical literature report that electronic medical systems to date have failed to improve communication across clinical users and domains (Ash, et al., 2004, Giuse and Kuhn, 2003). We proposed to develop and test progressive levels of integration in an electronic health record to quantify the value of each level of integration of HIT.

Setting & Participants: Organizational Outpatient-Inpatient Structure

Figure 1. Structure of outpatient clinics to inpatient hospital



*Clinics with dark Shading represent Phase I clinics
†Clinics with Herringbone pattern are Outlying Clinics that will have inpatient implementation only

There are approximately 2800 deliveries each year at OHSU hospital, of which 50% receive outpatient care either from Family Medicine, OB, or Midwifery within the institutional clinics. We implemented sequential HIT interventions in the OHSU, Family Medicine, Obstetric, and Midwifery clinics allowing us a contemporaneous control of women receiving care at outlying referral clinics.

Methods

Hypothesis

An integrated outpatient and inpatient health information system (HIT system) will improve patient safety and quality of health care.

Specific Aims

In order to address this hypothesis, we proposed to demonstrate real value through the following three aims:

I. Demonstrate the value of an integrated outpatient and inpatient health information technology system to improve quality of care and safety for women and infants, using group B Streptococcus (GBS) prevention as the test case

   a. Examine the effect of HIT system on direct patient care and other workflow in labor/delivery unit (Study Design: Work-sampling study): The workflow of medical staff (MD attending, resident and nurse) before and after HIT integration on computer work, paper work, talking to co-workers and personal/idle waiting and direct patient care were compared. ------ Workflow study

   b. Examine the quality of HIT system on documentation of key information in delivery admission (Study Design: Before-After Chart Review): The completeness of key information such as dating (EGA and source of EGA), chief complaint (contractions, rupture status, bleeding, fetal movement), and indications of pregnancy complication (fetal/contraction monitoring, vital status, lab report, infection history such as GBS and disease/medical history) before and after HIT integration were compared. ----- Comprehensiveness study

II. Demonstrate the value of an outpatient alert system to increase GBS screening. (Study Design: Prospective Intervention Study)

   a. Demonstrate that sequential degrees of HIT integration would decrease the number of women reported as "unknown GBS status" prior to delivery by improving transmission of results for women who are screened but previously failed to have results transmitted. ----- GBS screening study

   b. Demonstrate the value of an alert system to increase GBS screening: Determine whether implementation of an electronic system that includes defined fields for GBS screening increases evidence-based culture screening. Determine whether an alert system for evidence-based GBS screening increases appropriate culture screening. ----- GBS screening study

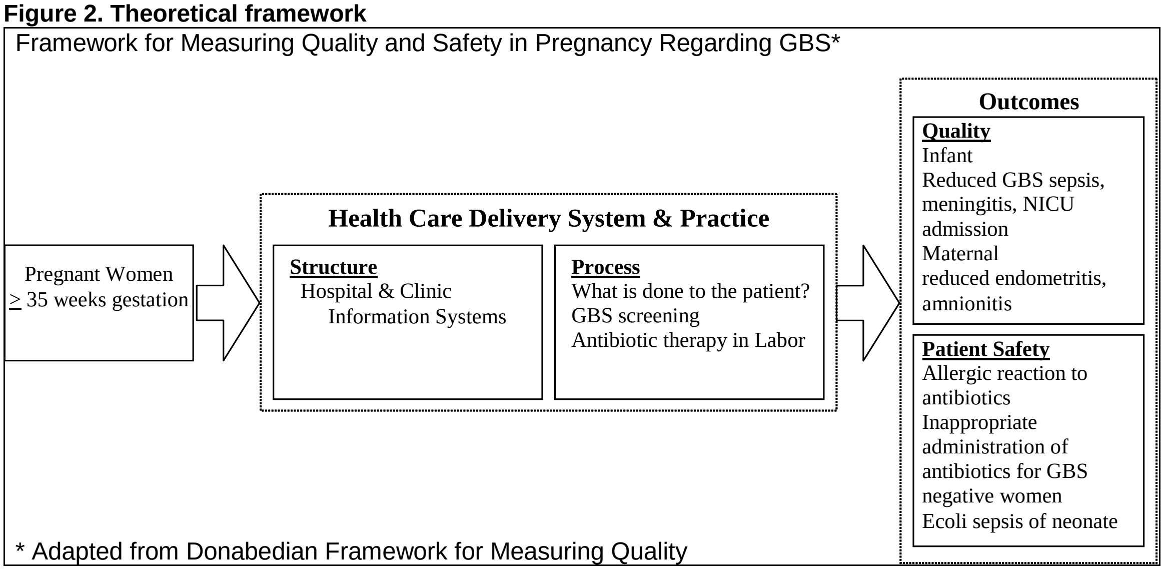
III. Perform a policy analysis comparing the costs and implications for GBS screening according to the US, Canadian, and UK policy to inform health care delivery and obstetric safety discussions (Study Design: Decision Model Cost and implications of policy)

   a. What are the cost or policy benefits when comparing the outcomes and costs of the United States, Canadian, and UK screening and treatment protocols?

Theoretical Framework

Below is the theoretical framework for this project.

Figure 2. Theoretical framework



According to this model, structure (that is the physical and organizational characteristics of the health care setting) and process (what is done to the patient), impact outcomes such as health. Although originally proposed over 40 years ago, the concept is timeless. For this proposal, we studied patients being admitted to labor and delivery after universal screening required that they receive GBS screening. Our intervention focused on structure. That is if our structure better reflects the experience of the patient rather than distinct inpatient and outpatient silos, can we provide better and safer care? This grant proposed to transform the information system to more accurately reflect the fluidity of patients' health care and to measure real and important differences in maternal and infant morbidity.

Intervention

We built an electronic obstetric record that rolled out sequential Hit interventions that incrementally increased the integration of outpatient and inpatient data and decision support.

Measures

We measured GBS screening rates, documentation, and treatment across each degree of HIT integration from paper at baseline, to inpatient electronic, to outpatient and inpatient, to decision support.

Results

Overall

This study provided valuable information on the benefit of HIT integration on medical documentation and patient care. Results from this study demonstrate that the HIT system can improve quality of patient care and patient safety without negatively impacting clinical care or workflow.

I. Demonstrate the Value of an Integrated Outpatient and Inpatient Health Information Technology System to Improve Quality of Care and Safety for Women and Infants, Using Group B Streptococcus (GBS) Prevention as the Test Case: a. Examine the Effect of HIT System on Direct Patient Care and Other Workflow in Labor/Delivery Unit (Study Design: Work-Sampling Study)

Workflow Study: AHRQ Advances in Patient Safety: New Directions and Alternative Approaches—the Impact of Health Information Technology on Work Process and Patient Care in Labor and Delivery

Emily M. Campbell, RN, MS; Hong Li, MD, MSPH; Tomi Mori, PhD; Patricia Osterweil, BS; Jeanne-Marie Guise, MD, MPH

Objective: Implementation of health information technology (HIT) is a national priority to improve patient safety, yet little is known about how electronic charting affects workflow and patient care in busy, fast-paced hospital units. We evaluated the impact of the introduction of an inpatient electronic health record (EHR) on clinical workflow in a high-volume labor and delivery unit in a large university hospital in the United States.

Methods: A work-sampling study was performed before and after implementation. Objective observers recorded workflow activities for 3.5-hour periods over nine work shifts (day, evening, night) during 2-week study periods before and after EHR implementation. Activities were standardized to counts per shift and compared using Wilcox two-sample tests.

Results: For all health care workers, after introduction of an EHR, direct patient care activities increased from a mean of 12.0 to 15.4 ($P = 0.004$); computer activities increased from 1.9 to 8.5 ($P < 0.0001$); and personal/idle time decreased from 3.1 to 1.4 ($P = 0.0002$).

Conclusion: The introduction of an EHR into a busy labor and delivery setting did not reduce time spent in direct patient care activities; instead, direct patient care activities increased.

Comprehensiveness Study: The Study on Quality of Medical Record—American Journal of Obstetrics and Gynecology: Examining the Value of Electronic Health Records on Labor and Delivery

Karen B. Eden, PhD; Rosalia Messina, MPA; Hong Li, MD, MSPH; Patricia Osterweil, BS; Carrie R. Henderson, BS; Jeanne-Marie Guise, MD, MPH

Objective: The objective of the study was to evaluate the impact of HIT system on documentation completeness and patient care.

Methods: We conducted a pre- and post-intervention study to compare documentation quality before and after HIT implementation.

Results: A total of 250 paper-based (pre-HIT) and 250 electronic-based (post-HIT) records were compared. Paper admission records were significantly more likely to miss key clinical information such as chief complaints (contractions, membrane status, bleeding, fetal movement, 10-64% vs 2-5%; $P < .0001$) and prenatal laboratory results and history (Varicella, group B Streptococcus, human immunodeficiency virus, 26-66% vs 1-16%, $P < .0001$).

Conclusion: This study indicated that the introduction of an obstetric HIT improved documentation completeness without reducing direct patient care.

II. Demonstrate the Value of an Outpatient Alert System to Increase GBS Screening (Study Design: Prospective Intervention Study)

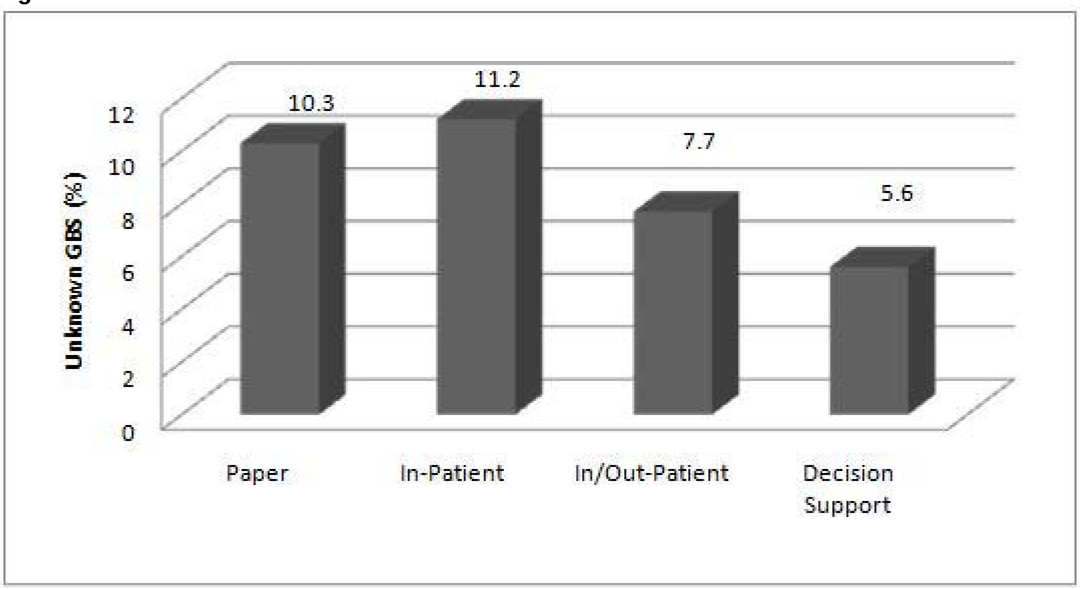
Pilot Study. As pilot data for feasibility and significance of this study, we examined documentation of GBS status for women at 36 weeks of gestation or greater (after usual timing for GBS screening) at or before the time of delivery for one month (January 2004). There were 186 deliveries with gestational age 36 weeks or greater that therefore would have been expected to have had GBS screening performed. During that time GBS status was unknown for one-third (33%) of all eligible patients. Unknown GBS status ranged from a low of 0% in family medicine clinics to 100% in perinatal patients (select group of patients from OHSU "Pavilion" clinic). On average for that month, 20% of patients within the OB clinics (pavilion + OHSU outpatient clinic, or OPC) had unknown GBS status and 40% of midwife patients had unknown GBS status. Fifty-seven percent of all patients were known to be GBS negative and 10% were known to be positive. All patients known to have a positive GBS screen received antibiotic treatment in labor. Whereas, 92% of patients without documented GBS status did not receive antibiotics in labor even though risk factors for GBS were present in half of these patients (e.g. prolonged rupture of membranes, temperature in labor etc).

The Value of HIT Integration on Quality of GBS Screening Record. We evaluated GBS screening records in women who admitted 36 weeks or beyond and had vaginal delivery from paper-based recording system and each level of integration phase (in-patient, in &out-patient, and complete integration with decision support system, see timeline in Table 1 below) in a large, fast-paced hospital. As the institution went from a paper-based admission chart to a fully integrated EHR, the rate of unknown GBS status significantly dropped from 10.3% to 5.6% (P for trend=0.002), similar pattern was observed in all gestational groups (EGA 36-36.9, 37-37.9 and >=38 weeks), shown in Figure 3 below. This study demonstrated that the integrated HIT system significantly improved physician awareness of GBS status, especially in HIT system with decision support.

Table 1. Timeline of HIT integration

Phase	Intervention	Timing	Chart Abstraction Dates
Paper (N=177)	Baseline: Paper Records (174 records)	Through February 28, 2005	October 1, 2004 – February, 28 2005
Inpatient HIT (N=267)	EHR, inpatient only (267 records)	March 1, 2005 through December 21, 2005	June 1, 2005 – December 21, 2005
In/Outpatient HIT (N=533)	EHR, inpatient/outpatient integration (533 records)	December 22, 2005 through October 31, 2006.	March 1, 2006 – October 31, 2006
In/Outpatient HIT + Reminders (N=770)	EHR, inpatient/outpatient integration, GBS screening reminders (770 records)	October 11, 2006 through present.	November 1, 2006 – March 17, 2008

Figure 3. Decline in unknown GBS status



III. Perform a Policy Analysis Comparing the Costs and Implications for GBS Screening According to the US, Canadian, and UK policy to Inform Health Care Delivery and Obstetric Safety Discussions (Study Design: Decision Model for Cost and Implications of Policy) (Publication 4)

Objective. To evaluate antibiotic use (for GBS) among women with different GBS status (positive, negative or unknown) and GBS risk factor and to compare the results against 3 GBS screening and treatment policies.

GBS Screening Policies: Canada, US, UK (in summary).

- Prior Canadian Policy: Screen all women and treat GBS positive and unscreened women (GBS unknown) who have documented risk factors for GBS (fever>37oC, rupture of membranes (ROM)>18 hours or estimated gestational age (EGA)<37) (Konrad, 2007).

- US and Current Canadian Policy (CDC, ACOG, Society of Obstetricians and Gynaecologists of Canada): Screen all women and treat GBS positive women and women with unknown GBS who display risk factors (Money, 2004; www.perinatology.com/protocols/GBS.htm)

- UK Policy (Royal College of Obstetricians and Gynaecolgists): Screen no women but treat women who have risk factors.

Note: All three policies treat women who have delivered an infant with invasive GBS disease. Therefore, this was not addressed in the comparisons of policies.

Methods and Results: Study Population. 1,277 women with EGA > 36 weeks who were delivered vaginally or by emergency cesarean section between 4/10/2005 and 3/16/2008.

Methods and Results: GBS Risk Factors. Any of the following: Fever>37oC, ROM>18 hours, EGA<37

Methods and Results: GBS Treatment. Information of antibiotic use was abstracted from the admit and delivery notes in STORC and from a separate, hospital-based information system. The following medications were considered as treatment for GBS:

- Ampicillin
- Penicillin
- Erythromycin
- Ancef (or cefozolin)
- Cefotan (or Cefotetan)
- Vancomycin
- Kefzol
- Clindamycin

The data were stratified in three ways: (1) GBS status (negative, positive, unknown);(2) presence of any GBS risk factor (fever>37^{o}C, ROM>18 hours or EGA<37) and (3) whether they were treated (or not) with one of the medications listed above.

From these tables, 218/264 (82.6%) of GBS+ women had documentation of treatment. Among GBS + women, only 19% (50/264) had at least one risk factor for GBS. Fifty-two percent (24/46) of women with unknown GBS status with at least one risk factor had treatment. Nine percent (72/808) of women with negative GBS were treated.

By the current US and Canadian policy: 310 women should have been treated. The actual data indicated that 242 of these women were treated and an additional 72 women with negative GBS status and 22 women with unknown GBS status and no risk factors were treated.

By the prior Canadian policy: 50 women who were GBS + and had risk factors and 46 women with unknown GBS status and risk factors (total 96 women) should have been treated. With this policy 214 women with GBS + status and no risk factors would not have been treated.

By the UK policy: 252 women with risk factors would have been treated. It is important to note that only 50/252 were GBS+ and this suggests that many GBS+ women were missed.

Table 2. GBS risk factors and treatment by GBS status

Factor	Negative n (%)	Positive n (%)	Unknown n (%)	P value
No. Patients	808 (63.3)	264 (20.7)	205 (16.0)	
Any GBS risk factors	156 (19.3)	50 (18.9)	46 (22.4)	0.56
Temperature > 38 ^{o}C	47 (5.8)	16 (6.1)	8 (3.9)	0.52
EGA < 37 weeks	32 (4.0)	16 (6.1)	22 (10.7)	0.0006
ROM > 18 hours	95 (11.8)	23 (8.7)	21 (10.2)	0.37
GBS treatment (Overall)	72 (8.9)	218 (82.6)	46 (22.4)	<0.0001
Among patients with at least one risk factor	43 (27.6)	44 (88.0)	24 (52.2)	<0.0001*

* CMH test

Summary Tables

Table 3. Characteristics of patients by GBS treatment

Factors	Overall (N=1277)	GBS Treatment No (n=941)	GBS Treatment Yes (n=336)	P value
Maternal age: Mean ± std		29.1 ± 5.7	29.0 ± 6.1	0.82
Maternal age : > 30	619 (48.5)	457 (48.6)	162 (48.2)	0.91
Nulliparous	339 (26.8)	249 (26.7)	90 (27.1)	0.90
GBS risk factors: Any risk factor	252 (19.7)	141 (15.1)	111 (32.7)	<0.0001
GBS risk factors: Temperature > 38 ^{o}C	71 (5.6)	17 (1.8)	54 (15.9)	<0.0001
GBS risk factors: EGA < 37 weeks	70 (5.5)	35 (3.7)	35 (10.3)	<0.0001
GBS risk factors: ROM > 18 hours	139 (10.9)	94 (10.0)	45 (13.2)	0.10
GBS status: Negative	808 (63.3)	736 (78.2)	72 (22.4)	<0.0001
GBS status: Positive	264 (20.7)	46 (4.9)	218 (64.1)	
GBS status: Unknown	205 (16.0)	159 (16.9)	46 (13.7)	
Out-patient clinic (Clinic with HIT)	591 (43.6)	389 (41.3)	202 (60.1)	<0.0001
Delivery route (Vaginal delivery)	1081 (84.6)	825 (87.7)	256 (76.2)	<0.0001
Infant disposition: MBU	1184 (95.2)	885 (96.5)	299 (91.4)	0.0009
Infant disposition: NICU	59 (4.7)	31 (3.4)	28 (8.5)	
Infant disposition: Morgue	1 (0.08)	1 (0.11)	0	

Table4. GBS risk and GBS treatment by GBS status in vaginal delivery by out-patient clinic type

Factors	Out-patient Clinic Type With HIT (OHSU) (n=461)	**Out-patient Clinic Type Without HIT (County) (n=620)**	P value
GBS status: Negative	299 (64.9)	380 (61.3)	<0.0001
GBS status: Positive	129 (28.0)	92 (14.8)	
GBS status: Unknown	33 (7.2)	148 (23.9)	
Any GBS risk factor	91 (19.7)	85 (13.7)	0.008
GBS treatment	146 (31.7)	110 (20.0)	<0.0001
Infant in NICU*	44 (7.6)	15 (2.3)	<0.0001

* Excluded 1 morgue

Decision Models of Three Policies

To evaluate these policies further, 2 decision models were created.

1. The first model, "Optimal treatment" used the OHSU data to provide the probabilities for: GBS +, GBS – and unknown status, GBS risk factors and the frequencies of the different types of medications (and associated costs). It then assumed perfect treatment, meaning that everyone that should be treated was treated with a single dose of medication. At the end of the decision tree branches were the direct costs provided by the manufacturers and published in ther Redbook, http://hopkins-abxguide.org. The model also included the cost of rapid assay screening, $150.

2. The second model was then created that displays the actual treatment paths and probabilities. These models were created in Treeage software. Because the models are so big, they are broken up by 3 major branches for this report: Optimal (3 pages): Prior Canadian Policy, US and current Canadian policy; and UK policy; and Actual Treatment (3 pages) Prior Canadian Policy, US and current Canadian policy; and Optimal UK policy.

Decision Models Observations

1. Both optimal and actual treatment decision models yield the lowest cost with the UK policy, $6/patient and $3/patient based only on screening and medication costs.

2. In looking at the optimal and actual treatment models for the US policy, the costs are identical, $134/patient but different women are treated. In the actual treatment model, women with risk factors are much more likely to be treated if they were GBS- or unknown GBS. The actual treatment model is much more complicated than the optimal model that relies less on risk factors and purely on policy of treating all GBS+ and only unknown GBS women with risk factors.

3. Surprisingly, the prior Canadian policy of only treating GBS + women who have risk factors cost almost as much as the US policy of treating all women who are GBS+, $128/patient. This approach of course requires ongoing monitoring of risks (which may

be more costly but isn't included in this model). Since < 20% of GBS positive women have risk factors, >80% of these GBS+ women are untreated.

4. An ideal decision model on this topic would carry the branches out to infant outcomes. Because it is so rare that a baby will be infected with GBS and our data set was limited to 1,277, the decision models were stopped at the treatment point. Without understanding how risk factors relate to the transfer to the infant, it is difficult to say which approach (Purely GBS screening approach vs. a risk factor approach vs hybrid) provides the most safety to the baby.

5. Ultimately, each approach treats very different groups of women.

Figure 4. Optimal treatment, prior Canadian policy

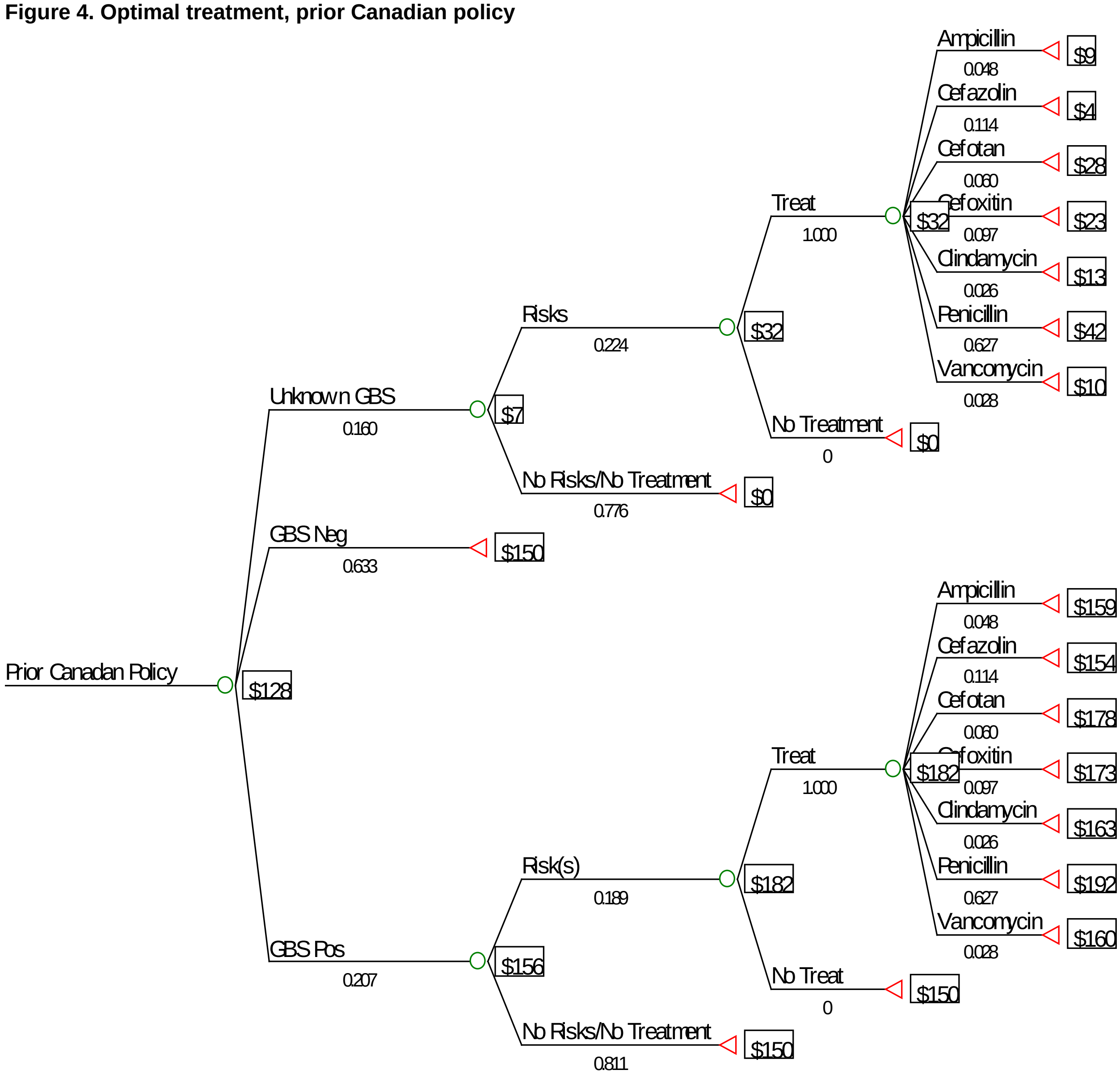


Figure 5. Optimal treatment, US and Canadian policy

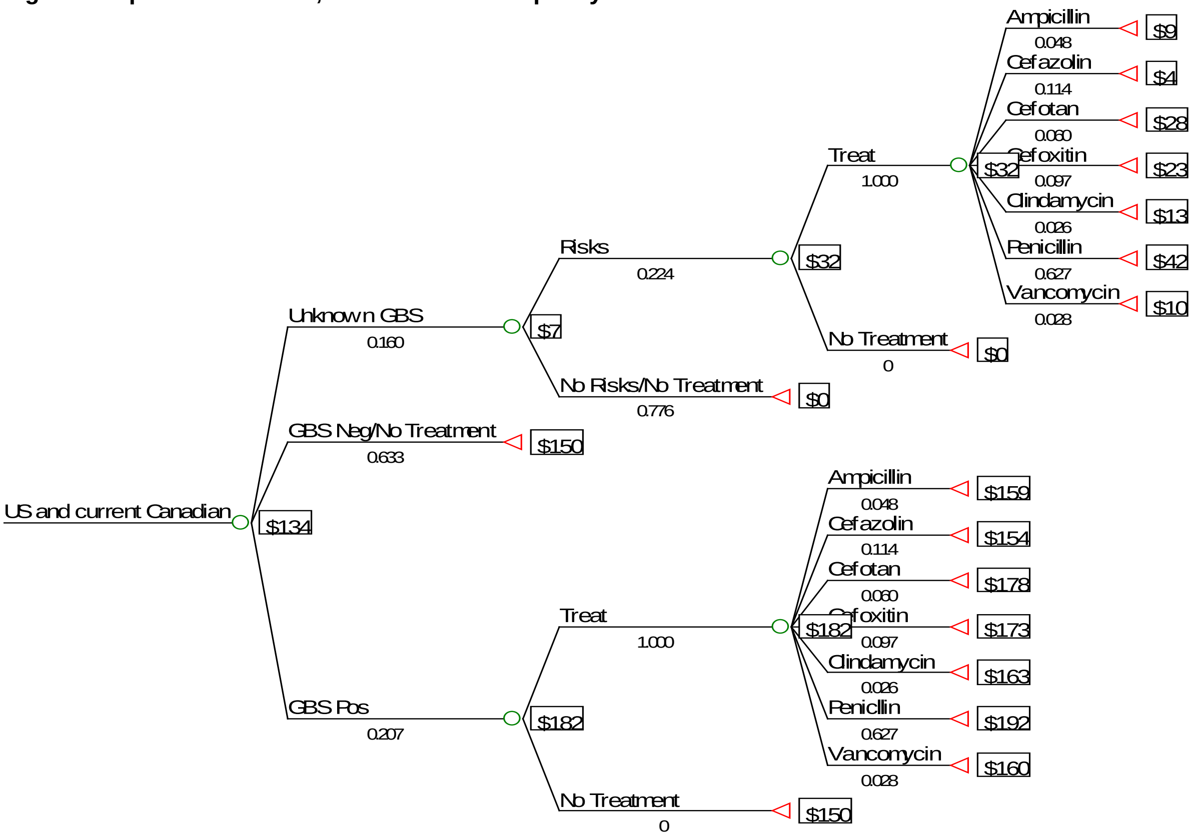
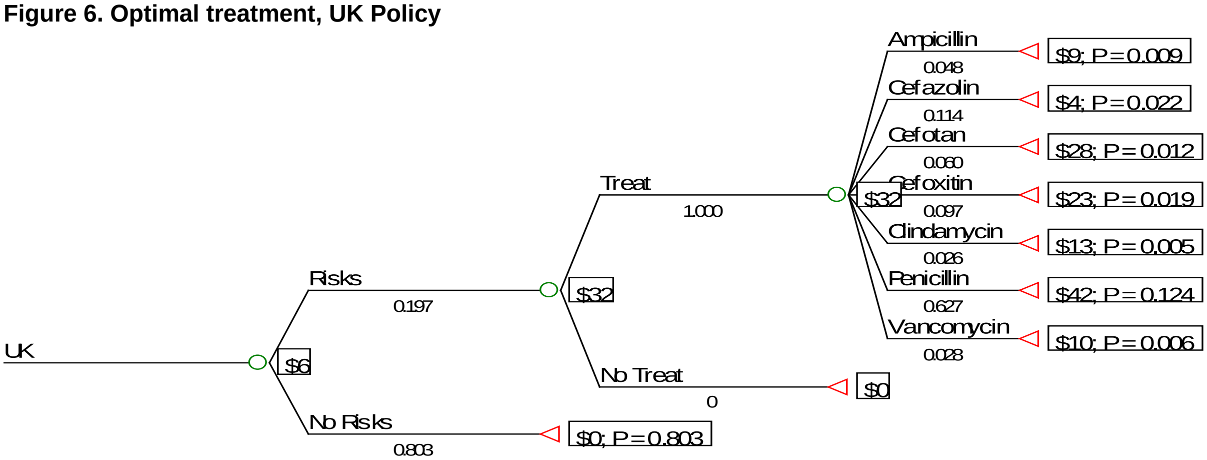


Figure 6. Optimal treatment, UK Policy



Note: Since the optimal policy in terms of cost alone is the UK policy, the path probabilities are displayed next to the payoffs at the end of each branch. If you multiply all of the probabilities along a path together, you get the path probability. For example, If you have risks and are treated with Ampicillin the path probability is computed as 0.197 * 1.00 * 0.048 = 0.009.

Figure 7. Actual treatment model: actual treatment, prior Canadian policy

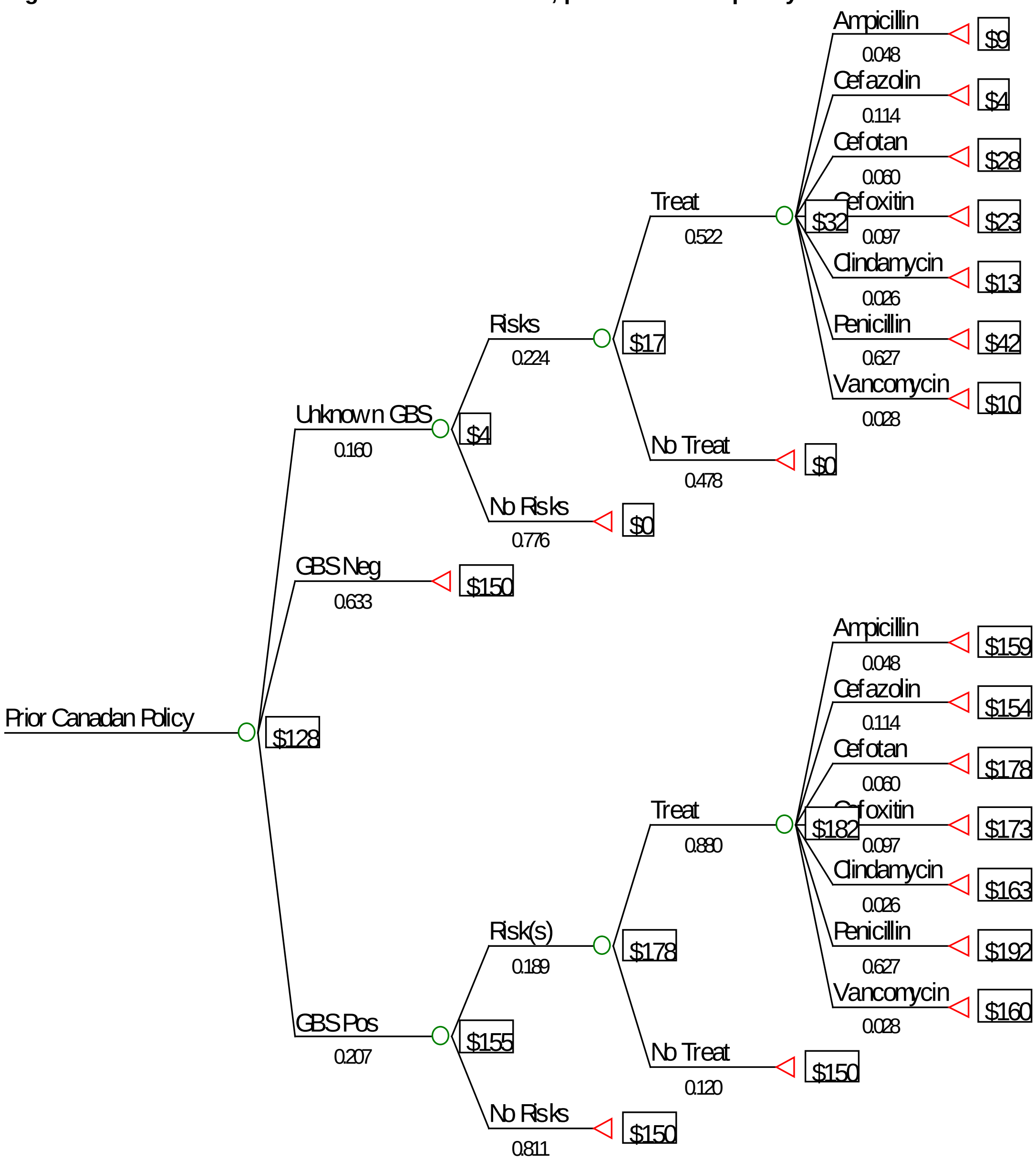


Figure 8. Actual treatment, US and current Canadian policy

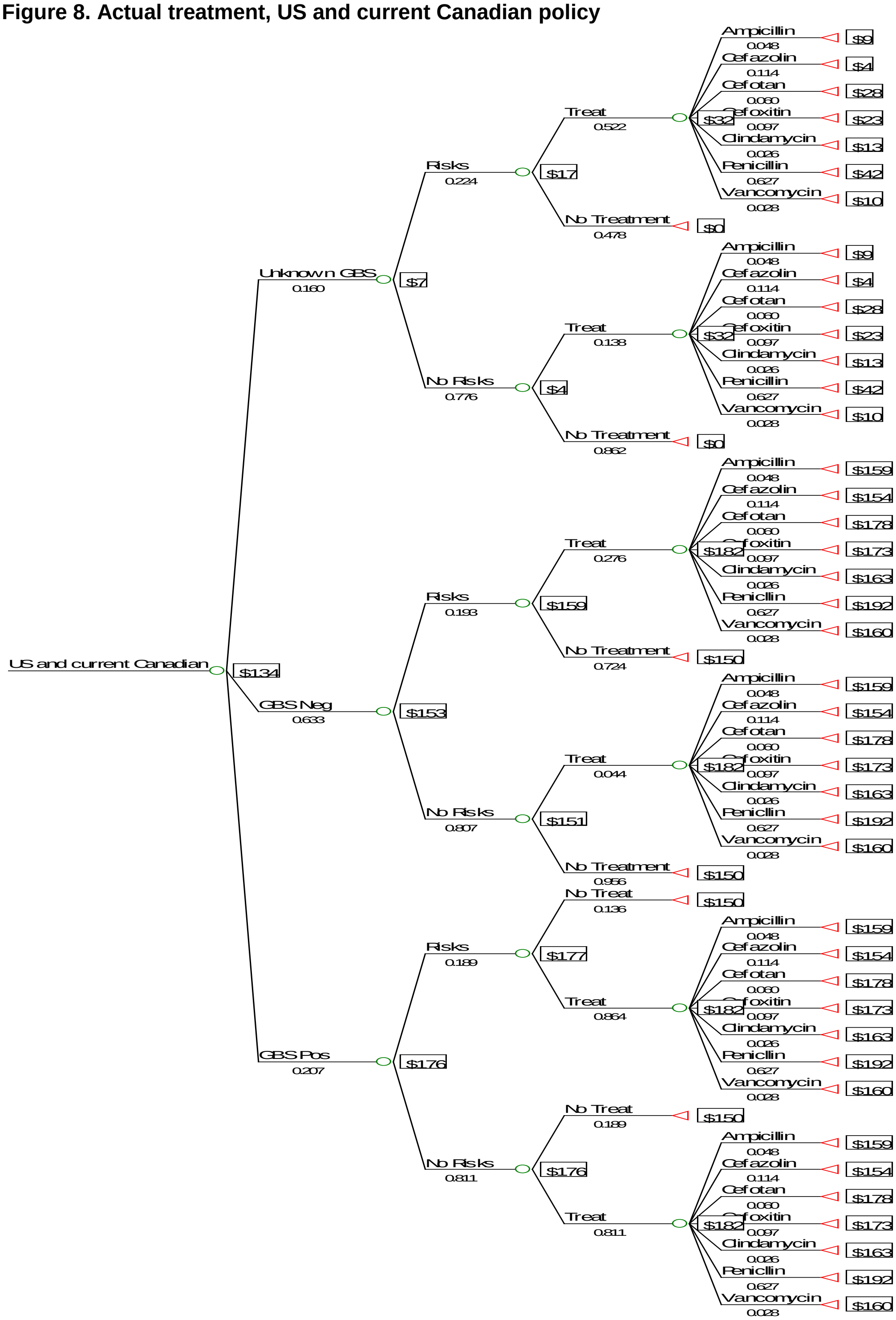
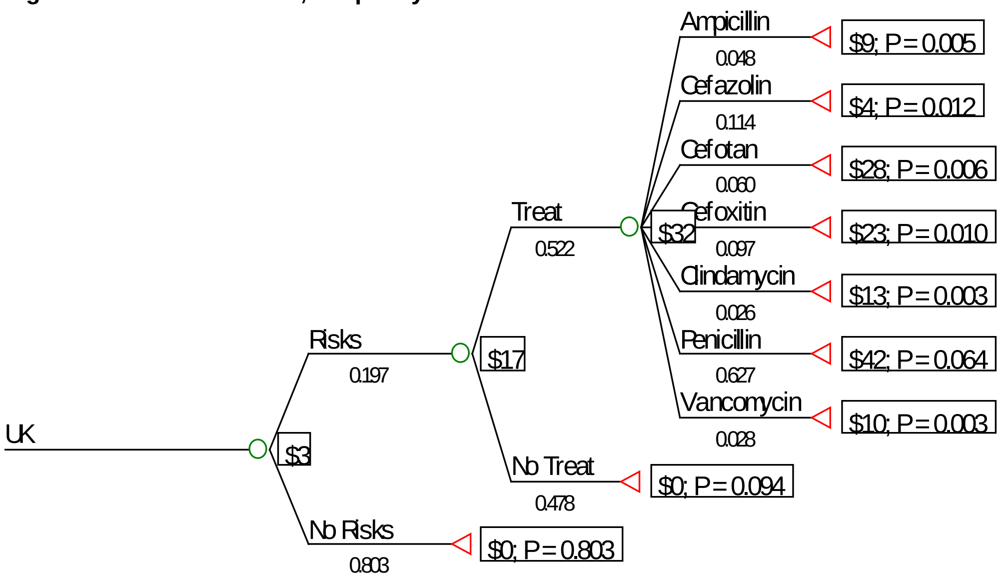


Figure 9. Actual treatment, UK policy



Note: Since the optimal policy in terms of cost alone is the UK policy, the path probabilities are displayed next to the payoffs at the end of each branch. If you multiply all of the probabilities along a path together, you will get the path probability. For example, If you have risks and are treated with Ampicillin the path probability is computed as 0.197 * 0.522 * 0.048 = 0.005.

Conclusion and Implications

The country believes that HIT holds a unique potential to improve patient safety and clinical efficiency. While there have been studies examining the value of specific intervention such as provider order entry, there has not been a systematic examination of the incremental gain in each level of HIT integration. Similarly, scarcely little research has been conducted to examine the challenges, barriers, and value of HIT relating to fast-paced obstetric care. Obstetric delivery and care of the newborn is the leading reason for hospitalization and a leading contributor to healthcare costs. Thus examination of the impact of electronic health records and the impact on safety for this population is critical to national health.

This study provides several results to inform both HIT and healthcare delivery discussion. The introduction of a clinical information system into a busy L&D setting did not reduce the amount of time providers spent in direct patient care activities, in fact, direct patient care activities increased. This study also demonstrated that obstetric HIT improved documentation completeness and communication of important clinical information to other providers. This study also demonstrated the incremental gains in patient safety achieved with each level of HIT integration. Having structured clinical data also enabled us to inform healthcare policy decision making by modeling the implications and costs of various countries healthcare policies relating to GBS.

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List of Publications and Products

Publications

1. Campbell EM, Li H, Mori T, Osterweil P, Guise J-M. The Impact of Health Information Technology on Work Process and Patient Care on Labor and Delivery. in Advances in *patient safety: New directions and alternative approaches. Vol. 4. Technology and Medication Safety*. AHRQ Publication No. 08-0034-4. Rockville, MD: Agency for Healthcare Research and Quality; 2008.

2. E. Eden, R. Messina, H. Li, P. Osterweil, C. Henderson, J-M. Guise. Examining the Value of Electronic Health Records in Fast-paced Obstetric Units. *American Journal of Obstetrics and Gynecology*. 199:307e1-307e9, 2008.

3. K. Eden, H. Li, P. Osterweil, and J-M. Guise. Electronic health records with decision support reduce uncertainty in Group B Streptococcus status. Planned submission to: *Obstetrics and Gynecology*.

4. GBS policy paper (in preparation)

Posters & Presentations

Agency for Healthcare Research & Quality Annual Meeting 2006: Improving OB Safety with HIT. Guise JM, Osterweil P, Case J. Clauder D. Oral Presentation at the AHRQ Patient Safety and Health IT 2nd Annual Conference, June 2006, Washington DC

Society for Maternal Fetal Medicine which was accepted for poster presentation to the annual meeting in Jan-Feb 2008: STORC OB SAFETY INITIATIVE: Catalyzing research while promoting clinical care and safety through OB Electronic Health Records Guise, J-M MD MPH, Messina R, BS, Hong Li, MD MPH, Osterweil P BS, Henderson C BS, Mori M, PhD, Eden, KB PhD

American College of Obstetricians and Gynecologists 57th Annual Clinical Meeting (ACM) May 2009. Chicago Ill.(awarded Blue Ribbon) Electronic health records with decision support reduce uncertainty in Group B Streptococcus status Guise JM, Eden K, Osterweil P, Li H.

Honors & Prizes

1st prize Blue Ribbon Award for Scientific Poster Presentation at the 2009 Annual ACOG Meeting

Abstracts

Society for Maternal Fetal Medicine which was accepted for poster presentation to the annual meeting in Jan-Feb 2008: STORC OB SAFETY INITIATIVE: Catalyzing research while promoting clinical care and safety through OB Electronic Health Records Guise, J-M MD MPH, Messina R, BS, Hong Li, MD MPH, Osterweil P BS, Henderson C BS, Mori M, PhD, Eden, KB PhD

Advanced in Patient Safety: New Directions and Alternative Approaches. Objective: Implementation of health IT is a national priority to improve patient safety, yet little is known about how electronic charting impacts workflow and patient care in unpredictable, fast paced, procedurally driven hospital units. As part of a larger, AHRQ-funded patient safety health IT study (R01 HS015321), we evaluated the impact of an inpatient electronic charting system (e-STORC) on clinical workflow in a fast paced high volume labor and delivery unit. Data Sources/Study Setting: A labor and delivery unit at a large US University hospital. Study Design: A work sampling study was conducted before and after implementation of an inpatient electronic health record. Data Collection/Extraction : A list of providers and nurses on duty each shift were randomly assigned observation times throughout a 3.5 hour observation period. An objective observer recorded workflow activities using a structured data collection sheet for 3.5 hours of an 8 hour shift (day, evening, night) with a total of 9 shifts over each 2-week study period before and after implementation. Activities were standardized to counts per shift and compared using Wilcox two-sample test. Principal Findings: A total of 195 observations were made (61.5% nurses and 38.5% physicians). For all healthcare workers, direct patient care activities increased from a mean of 12.0 to 15.4 (p=.004), and computer activities increased from 1.9 to 8.5 (p<.0001) while personal/idle time decreased from 3.1 to 1.4 (p=.0002) after introduction of e-STORC. This pattern was seen for both nurses and physicians across all activities.Conclusions: The introduction of a clinical information system, e-STORC, into a busy L&D setting did not reduce the amount of time providers spent in direct patient care activities, in fact, direct patient care activities increased.

Examining the Value of Electronic Health Records on Labor and Delivery. Objective: Evaluate the impact of an electronic health record (EHR) on document quality and patient care in a labor and delivery unit. Study Design: We conducted a pre-post intervention study to compare documentation quality and workflow before and after EHR implementation. Documentation was compared using chi-square and Fisher's exact tests. Objective observers measured workflow activities across all shifts before and after EHR implementation and activities were compared using Kruskal-Wallis tests and analysis of covariance. Results: Paper admission records were significantly more likely to miss key clinical information such as chief complaints (contractions, SROM, bleeding, fetal movement, 10-64% vs. 2-5%; p<0.0001); and prenatal labs and history (Varicella, GBS, HIV,26-66% vs. 0.8-16% , p<0.0001). Both direct patient care and computer activities increased after EHR implementation (2 vs. 13 and 12 vs. 17 activities/shift, respectively, p<0.0001). Conclusion: The introduction of the STORC obstetric EHR improved documentation quality without reducing direct patient care.