Use of potassium hydroxide (KOH) test reduces antifungal medication use for suspected monilial diaper dermatitis in the Neonatal Intensive Care Unit (NICU): A quality improvement project

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Objectives
By the end of this talk, the participant will be able to:

1. Explain the difference between a quality improvement project and research.
2. Suggest how the “KOH” project meets the criteria for a quality improvement (QI) project.
3. Define antimicrobial stewardship.
4. Describe how this QI intervention avoids inappropriate use of antifungal.
5. Suggest QI projects for your own NICU’s?

Translation of Evidence into Practice: Research vs Quality Improvement

Research (Empirical Method) Goals: To find “truth”

- To acquire new knowledge, or dispute, correct, or integrate old knowledge, based upon empirical or measurable evidence subject to specific principles of reasoning.

Where Does Research vs QI Occur?

Research (Empirical Method)

Goals: To find “truth”
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Approaches to Randomized Controlled Trial

- Based upon observation, formulation of a question
- Hypothesis statement: Statistical, Null
- Testing
- Analysis
- Conclusion
- Sometimes, theory-building
- Example: Does caffeine improve long-term mental developmental quotient?
What are Concepts and Principles of Quality Improvement?

- Quality Improvement involves methods to evaluate health care interventions and systems, with the goal of improved clinical care, patient safety, efficiency and overall patient experience.
- Central concept in QI is implementation of incremental change, followed by measurement of the effects of these changes over time.
- Through incremental change, one learns along the way and can make corrections, to improve outcome.

Approaches to QI Evaluation

- Plan, Do, Study, Act
- Context + Mechanism = Outcome
- Qualitative Methods
- Example: Implement bundle of evidence-based approaches to decrease post C-sec wound infections in obese patients.
- Borrow from other disciplines:
  - Statistical process control
  - Time series analysis
  - Root cause analysis
  - Simulations
  - Factorial experiments

Elements of QI Project Description
Schreifer and Leonard, 2012

- Project Title
- Project Champions
- Background
- Problem
- Initiative
- Baseline Data
- Benchmark
- Target
- Process Measures, Clinical Outcome Measures, Patient/Family Satisfaction Measures, Financial Outcome Measures, Balancing Measures

QI Expression of Process Change
Schreifer and Leonard, 2012, p. 355

What are Tensions Between Research and QI?

**Pro Research**
- Lack of rigor in other than RCT may allow the investigator to reject the null hypothesis even when it is true.
- Bias may be allowed to affect results and allow harm; or may threaten valid inference.
- Goal is to find “truth”.
- Research should generate or refute knowledge.

**Pro QI**
- Best Evidence too narrowly defined.
- Approach to gathering evidence too constrained.
- RCT great for well-defined interventions (e.g. tests, drugs, procedures) but may not work as well for complex concepts (e.g. systems, approaches, non-linear social changes).
- QI project analysis should measure that you have successfully translated evidence-based research into practice.

Issues to Consider with Projects

- Is the intervention already based in evidence?  
- Is this project one in which a system is changed to translate good evidence into practice?  
- Are some of the patients or clients receiving an intervention while others are not?  
- Are questions being asked to develop causal relationships and new knowledge?  
- In the project, are you measuring that you have successfully translated evidence-based research into practice?
Why is Translation of Research Critical?

“The best new treatments will achieve little if they never reach reach the patients for whom they were developed.” (Westfall et al., 2007, p.406)

Background of KOH to Dx monilial diaper dermatitis (MDD) QI Project

• Despite availability of rapid fungal tests, e.g. KOH test, many neonatal nurses and care providers rely on visual assessment of diaper dermatitis to determine the diagnosis of monilial diaper dermatitis.
• This may result in overtreatment with anti-fungal topical medicine, with resulting exposure and costs.

Incidence

• Diaper dermatitis is a common problem in the newborn and causes great anxiety for parents.
• Diaper dermatitis occurs in over 10% of all infants, and leads to up to 20% of childhood dermatology visits.
• Mucocutaneous candida infection was found in up to 8% of LBW infants weighing <1500g, and up to 16.5% among those weighing <1000g (Chapman & Faix, 2003).
• Candida is not the cause of all diaper dermatitis but is the focus of this study.

Diagnosis of MDD

• Difficult to dx.
• Clinical symptoms are well-established, but fungal tests and cultures remain the standard.
• The potassium hydroxide (KOH) prep test is a quick and inexpensive fungal test to differentiate Candida albican and dermatophytes from other skin disorders.

Significance: Monilial Infection in NICU

• Prior to the 1980’s, monilial infection in the newborn thought to be due to contaminants, tx thought to be toxic, and late diagnoses of systemic infection were, often, made at death.
• Since then, topical anti-fungals, with high penetrative qualities, and with few toxicities, have been developed for treatment of early cutaneous infection.
• Colonization of infants in NICUs, by candida species, such as occurs with monilial diaper dermatitis, or mucocutaneous candidiasis, increases the risk of systemic infection and may precede systemic infection.

Significance

• Anti-microbial stewardship is recommended.
• Under-diagnosis of neonatal candidiasis in high-risk infants can lead to multi-focal disease, significant morbidity, and death.
• Over-diagnosis may lead to resistance.
Purpose

• To implement a QI project study to determine if the use of a fungal KOH test, when monilial diaper dermatitis (MDD) is suspected, will produce more accurate diagnoses, with decreased antifungal medication exposure.

Methods

Design: QI project method with new protocol in 2017 for treatment of MDD after KOH+ testing. Ordering systems were established in collaboration with pharmacists. Staff training was performed. If monilial rash suspected, after two KOH-tests, then antifungal ordered (considered false negative).

Sample: Neonates in two Level III NICUs.

Outcome Variables: KOH test results, use of antifungal medication, cost.

Analysis: Cost was determined. Chi-square testing to determine differences.

PDSA Cycle of KOH/MDD QI Project

Act:
- Change practice
- Disseminate results

Plan:
- Proposal
- Approve with stakeholders

Do:
- Change systems
- Teach
- Support

Study:
- Analyze data
- Summarize

Act:
- Change practice
- Disseminate results

Sample of Educational Poster

HOW TO OBTAIN A KOH CULTURE/STAIN TO TEST FOR A FUNGAL INFECTION

• Obtain a tongue depressor, orange top specimen container and sterile scissors
• Draw an arrow across the width of the depressor pointing to the edge and location where the sample will be collected.
• Cut the tongue depressor so it will fit into the specimen container
• Don gloves
• Scrape the suspected fungal area with the edge and location to which the arrow points
• Place tongue depressor in orange top specimen container and close
• Place the patient’s carefusion label on the specimen container
• Send to lab

Analysis

• Pre and post intervention data were collected.
• Chi-Square and segmented regression.
• Costs of laboratory diagnosis and treatment were determined.
Costs Used for Analysis

<table>
<thead>
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<th>Costs Used for Analysis ($)</th>
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<tr>
<td>Nystatin Cream or Ointment</td>
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<tr>
<td>Miconazole</td>
<td>7.80</td>
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<tr>
<td>Clotrimazole</td>
<td>1.98</td>
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<tr>
<td>KOH prep</td>
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Results of KOH for MDD QI Project

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<tr>
<th>Year</th>
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<th>KOH- or No Tx</th>
<th>KOH+ or Tx</th>
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*p=0.0001, 95% CI 0.91-0.96

Versus Cost of KOH Test Quality vs Cost?

- There was a 64% reduction in the use, and 63% decreased cost, of antifungal agents.
- Overall cost, including cost of KOH test, increased by 591%, but was still low (<$3700/year for 2 NICUs)
- One infant received three negative KOH tests, then one positive one. This would have met the definition of a false negative test, per protocol.
- There were no cases of fungal sepsis.
- Need to weigh the benefits of diagnostic accuracy versus minimal increased costs of KOH testing.

Results and Conclusion

- These results indicate that a QI protocol in which the use of KOH testing is required, before antifungal agents are prescribed, may result in decreased exposure with minimal increased cost.
References

- Beekman O, Schiltz P, Li, Vermeir M, Huyers M, A., B.