QUALITY IMPROVEMENT PROJECT COMPLETION DOCUMENT

IMPACT

Describe the EVALUATION of the outcomes of the project as they relate to the project's aim and deliverables.

The project aim was twofold: first, to improve the documentation for dealing with positive cultures, and second, to create an algorithmic approach to dealing with positive blood cultures in order to improve patient safety and physician workflow.

The Form

The previous procedure of documentation was disorganized, confusing, and was not appropriate for a medico-legal document. This was especially true when a culture result required multiple days of follow-up (waiting for species identification, sensitivities, or failed attempts to reach the patient). We developed an improved form, in a simplified yet detailed checkbox format, that improved on these issues. (see attached appendix A)

The Algorithms

We began with a physician questionnaire that presented clinical vignettes that involved blood culture interpretation and management to our ED physicians. The responses indicated that there was lot of misunderstanding of how these cases should be approached and inconsistency in the management of these cultures.

This was followed by two presentations at the monthly physician meetings, which included educational reminders about how to manage positive blood cultures. We supplemented the educational initiatives by developing useful tools to aid in the application of these management principles. Following a thorough literature search, we developed clinical decision support algorithms and tables to improve and standardize physician management in dealing with positive cultures. Three algorithms were developed (management of the positive gram stain, management of the positive culture after species identification, and management of positive cultures in patients with central lines). We collaborated with our colleagues in the microbiology department for input. We also prepared text documents with additional information to assist with the algorithms (see appendices B-G)

We will continue to elicit feedback from the physician group on all of these materials, and may look directly at the rate of callbacks and patient outcomes in subsequent projects. We have previously surveyed the physician group regarding their confidence in managing positive blood cultures, and following the implementation of the algorithmic resources, plan to repeat the survey to measure any improved confidence in 6 months' time.

MILESTONES

Describe the various MILESTONES delineated in your project charter and when/how they were achieved.

Physician survey#1: July 2014
Culture callback form completion: Aug 2014

Physician education #1: Sept 2014
Algorithm completion: Jan 2016
Physician education #2: Jan 2016
Physician survey#2: planned for Aug 2016

LESSONS

Describe the LESSONS, individual or organizational, learned through this project.

This project stressed the need for close interdepartmental collaboration to elicit change, especially in the ED where we likely interact with more specialities than any other physician group at UHN. The path from conception of the project to the final product took several years and countless hours of labour from a dedicated team. It was often difficult to maintain momentum and interest due to the amount of literature review required, the number of revisions needed, and delays in consulting with other departments and interested parties. Through this project we have learned insights into team selection and dynamics, which will definitely serve us well in future projects.

"If necessity Is the mother of invention then frustration is father of creativity" - Avinash Wandre

RECOMMENDATIONS

Describe the IMPLICATIONS of this project for patient care or for future projects.

With the previous system of culture follow-up, documentation was often messy and difficult to decipher. For the physician continuing the follow-up process on subsequent days, it was often difficult to figure out what had already been done. This led to delays in appropriate care, and inefficient use of physician time. Our improved form has aimed for improvement on both of these fronts.

With regards to appropriate management of positive cultures, it was clear from our first physician survey that 10-20% of our physicians were not managing certain cultures appropriately (e.g. waiting for species identification in coagulase-negative staphylococcus), and many physicians had no clear approach to certain species results. With this in mind, our algorithmic approach to handling positive cultures has standardized the care we provide and ensures that patients are being cared for appropriately and safely.

DISSEMINATION

Describe the completed or planned steps for DISSEMINATION of this project's findings (e.g., presentations, posters, manuscripts, etc).

With respect to the algorithms, we plan to gather additional feedback from the physician group after 6 months of user experience. We will assess usability and improved confidence in dealing with positive cultures. Then we will further streamline the algorithms, and disseminate them to the other emergency departments in Toronto and beyond. We plan to submit our results for presentation at emergency medicine conferences.

Appendix A – Positive culture follow-up document

UHN Emergency Department Culture Results Follow-Up Form

Ward Clerk:_____
Today's Date/Time _____
Date of ER Visit: _____
If blood culture -were 2 sets drawn? yes no

Patient Name/MRN

Charge RN: _____ Signature: _____
Blood Urine Throat Wound Stool Other _____
Preliminary Final Final with sensitivities
Antibiotic prescribed in ED: _____

What Action Is Required?

1. **Case Closed** (no f/u needed, correct antibiotic)

2. **Await sensitivities** (*NEVER appropriate for positive BLOOD cultures)

3. **Call patient for reassessment by phone**

Date &Time of attempted contact: _____

Outcome
Patient's clinical condition does not require further action (Case Closed)
Prescription for pick-up in ED
Prescription for faxing to pharmacy Pharmacy info: _____
Patient confirmed they will return to ED for reassessment

Unable to reach patient
Voicemail left to call back at TWH ED 416-603-5190 or TGH ED 416-340-3947
Continue attempts by ward clerk Q30min x2hours & notify MD if no response
Incorrect phone number on EPR (tried canada411.ca)
Outcome following patient contact: Time:_____ Date:_____
Action: _____
_____
_____

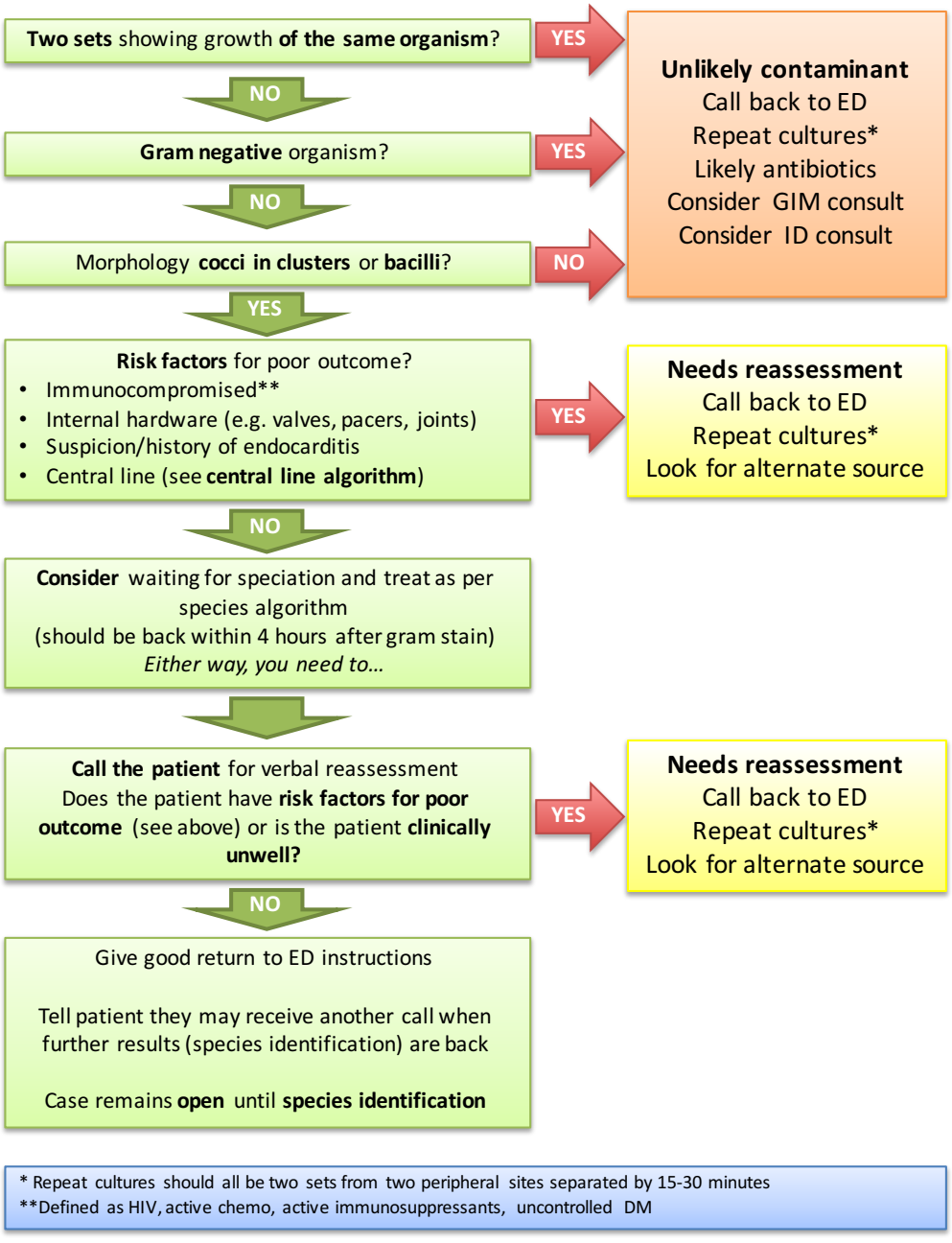
4. **Other (Specify Below)**

Additional Comments: EPR ED Follow-up Note Completed? Yes No
_____
_____
_____
_____

MD completing this form: _____ Signature: _____

Appendix B – Blood culture interpretation by preliminary gram stain

Positive Blood Culture Algorithm – by Gram Stain



* Repeat cultures should all be two sets from two peripheral sites separated by 15-30 minutes
**Defined as HIV, active chemo, active immunosuppressants, uncontrolled DM

Last updated 2016-02-02

Appendix C – Blood culture interpretation by species identification (first page)

Species	Gram Stain	Morphology		Coagulase	Subclassification	Approx % chance of true bacteremia if single bottle positive	Risk Group	Will sensitivities be done?
Acinetobacter baumanii	Gram neg	bacilli				>80	High	YES
Aerococcus spp.	Gram pos	cocci	clusters			<10	Low	YES
Bacillus anthracis	Gram pos	bacilli				>80	High	YES
Bacillus spp. (except B. anthracis)	Gram pos	bacilli				<5	Low	NO
Bacteroides spp.	Gram neg	bacilli			anaerobe	95	High	NO
Campylobacter spp.	Gram neg	bacilli				>90	High	NO
Candida spp.	Fungi				Fungi	98	High	NO
Citrobacter spp.	Gram neg	bacilli			Enterobacteriacea	>90	High	YES
Clostiridium perfringens	Gram pos	bacilli			anaerobe	25	Intermediate	NO
Clostridium botulinum	Gram pos	bacilli			anaerobe	>80	High	NO
Clostridium difficile	Gram pos	bacilli			anaerobe	>80	High	NO
Clostridium spp. (except C. botulinum, C. difficile, C. tetani)	Gram pos	bacilli			anaerobe	64	High	NO
Clostridium tetani	Gram pos	bacilli			anaerobe	>80	High	NO
Coagulase-negative Staphylococcus spp. (except S.lugdunesis)	Gram pos	cocci	clusters	coag-neg		15	Low	NO
Corynebacterium jeikeinum	Gram pos	bacilli				>80	High	YES
Corynebacterium spp.(except C. jeikeium)	Gram pos	bacilli				<5	Low	NO
Crypotococcus neoformans	Fungi				Fungi	100	High	NO
Enterobacter cloacae	Gram neg	bacilli			Enterobacteriacea	93	High	YES
Enterobacter spp.	Gram neg	bacilli			Enterobacteriacea	90	High	YES
Enterococcus spp.	Gram pos	cocci	chains	α-hemolytic		70	Intermediate	YES
Escherichia coli	Gram neg	bacilli			Enterobacteriacea	99	High	YES
Group B *Streptococcus*	Gram pos	cocci	chains	β-hemolytic	Group B strep	>90	High	YES
Haemophilus influenza	Gram neg	coccobacilli				100	High	YES
Klebsiella pneumoniae	Gram neg	bacilli			Enterobacteriacea	95	High	YES
Klebsiella spp.	Gram neg	bacilli			Enterobacteriacea	>90	High	YES
Lactobacillus spp.	Gram pos	bacilli			anaerobe	50	Intermediate	NO
Listeria monocytogenes	Gram pos	bacilli				>80	High	NO
Micrococcus spp.	Gram pos	cocci	clusters			0	Low	NO
Moraxella catarrhalis	Gram neg	diplococci				>90	High	NO
Morganella spp.	Gram neg	bacilli			Enterobacteriacea	>90	High	YES
Mycobacterium spp.	Gram pos	bacilli			Mycobacteria	100	High	YES
Neisseria gonorrhoeae	Gram neg	diplococci				>80	High	NO
Neisseria meningitidis	Gram neg	diplococci				>80	High	YES
Nocardia spp.	Gram pos	bacilli				>80	High	NO
Paenibacillus spp.	Gram pos	bacilli				<5	Low	YES
Peptosteptococcus spp.	Gram pos	cocci	chains		anaerobe	40	Intermediate	NO
Propionibacterium spp.	Gram pos	bacilli			anaerobe	3	Low	NO
Proteus spp.	Gram neg	bacilli			Enterobacteriacea	>90	High	YES
Providencia spp.	Gram neg	bacilli			Enterobacteriacea	>90	High	YES
Pseudomonas aeruginosa	Gram neg	bacilli				96	High	YES
Pseudomonas spp. (except P.aeruginosa)	Gram neg	bacilli				75	High	NO
Rhodococcus spp.	Gram pos	bacilli				<5	Low	YES
Salmonella spp.	Gram neg	bacilli			Enterobacteriacea	>90	High	YES
Serratia marcescens	Gram neg	bacilli			Enterobacteriacea	95	High	YES
Shigella spp.	Gram neg	bacilli			Enterobacteriacea	>90	High	YES
Staphylococcus aureus	Gram pos	cocci	clusters	coag-pos		90	High	YES
Staphylococcus lugdunesis	Gram pos	cocci	clusters	coag-neg		>80	High	YES
Stentotrophomonas maltophilia	Gram neg	bacilli				80	High	YES
Streptococcus agalactiae (Group B strep)	Gram pos	cocci	chains	β-hemolytic	Group B strep	75	High	YES
Streptococcus anginosus	Gram pos	cocci	chains	α-hemolytic	Viridans strep	35	Intermediate	YES
Streptococcus bovis	Gram pos	cocci	chains	β-hemolytic	Group D strep	30	Intermediate	YES
Streptococcus dysgalactiae	Gram pos	cocci	chains	β-hemolytic	Group C strep	30	Intermediate	YES

Appendix D – Action required based on species risk category

Positive Blood Culture Action Required - based on species risk category

HIGH RISK - Unlikely Contaminant

1. Call back to ED
2. Clinical reassessment
3. Repeat cultures*
4. Strongly consider antibiotics
5. Consider GIM/ID consult

INTERMEDIATE RISK - Possible Contaminant

1. Call back to ED
2. Clinical reassessment
3. Repeat cultures*
4. Consider antibiotics
5. Consider GIM/ID consult

LOW RISK - Common Contaminant

IF
1. Only one of two sets positive, AND
2. No risk factors**, AND
3. No fever of unknown origin ***, AND
4. Patient clinically well over the phone

THEN Case closed

OTHERWISE
1. Call patient back to ED
2. Clinical reassessment
3. Repeat cultures*

Notes:

* Repeat cultures should be two sets from two peripheral sites >30 minutes apart. (If possible endocarditis or "Fever of Unknown Origin" then do 3 sets from 2-3 sites each >30 min apart)

** Risk factors include immunocompromise, internal hardware (especially valves or lines), risk of endocarditis

*** Defined as unexplained fever > 1 week or 3 outpatient visits despite appropriate investigations

Appendix E – Supplemental information for algorithms (first page)

POSITIVE BLOOD CULTURES FOR DISCHARGED PATIENTS: AN UHN ED APPROACH

AT UHN: Organism identification occurs within about 4 hours of a gram stain (except weekend evenings). Susceptibilities are resulted the following day (except on weekends).

For ANY positive culture:

- Check EPR for most recent sensitivity information and for other culture results (NOT ALL BUGS WILL HAVE SENSITIVITIES DONE ROUTINELY)
- Check EPR for all cultures drawn on that same date to see if there are MULTIPLE positive isolates (the most common missed infection is the... second, third...)
- **ALL PATIENTS NEED TO BE CALLED.** If there is any question of clinical status, call them back to ED for evaluation

A few words about (skin) contamination:

- Many bugs almost always represent true bacteremia (see alphabetical species list)
- Others are often contaminants:

  THERE ARE EIGHT COMMON CONTAMINANTS:

  Three are **gram positive cocci in clusters**:
  Coagulase-negative Staphylococcus species (except S. lugdunesis)
  Micrococcus spp.
  Aerococcus spp.
  Five are **gram positive baccili**:
  Bacillus spp. (except B. anthracis)
  Corynebacterium spp. (except C. jeikeium)
  Propionibacterium spp.
  Rhodococcus spp.
  Paenibacillus spp.

- A special note about **COAGULASE-NEGATIVE STAPHYLOCOCCUS**:

  There are 29 species of coagulase-negative staphylococcus (eg: *S. epidermis, S. saprophyticus, S. hominis, S. lugdunensis)*. They are a common contaminant that are challenging to assess. They are the most commonly grown bug and account for as many as 40% of positive blood cultures. Most of the time this represents skin contamination, but 5-15% of the time this represents REAL BACTEREMIA, especially in the right clinical context. Patients at risk include those with internal hardware (prosthetic valves, pacemakers, intravascular catheters, prosthetic joints or other foreign bodies) those at risk of endocarditis and immunocompromised hosts. The exception to this is *S. lugdunensis*, which appears capable of causing more invasive infections, including NATIVE VALVE ENDOCARDITIS.

- So, never assume that a blood culture is a contaminant, because even common contaminants can cause significant infections (especially in the immunocompromised). In order to determine

Appendix F – Clinical decision guide for appropriate blood culture ordering (first page)

OPTIMAL ORDERING OF BLOOD CULTURES

1. We draw 2 sets of cultures in order to get enough VOLUME of blood. 3 sets do NOT increase the sensitivity significantly, with the exception of suspected endocarditis or "Fever of Unknown Origin".

2. We draw from 2 SITES in order to be able to interpret blood contaminants.

3. We draw 30 minutes apart in order to help see if the bug is being shed continuously, and therefore more likely to represent an endovascular source.

4. So, if you are going to draw cultures, do one anaerobic and one aerobic bottle from at least 2 different sites >15min apart.

5. If the patient has a CVC: 1 draw from the catheter, another from a peripheral site. If not possible, then 1 set from each lumen.

6. Consider that if the patient is well enough to go home, they likely do not need blood cultures. (Exception would be in the immunocompromised or in those in whom you suspect an occult bacteremia).

7. Blood cultures have a very low yield in community acquired pneumonia.

8. Blood cultures may be most helpful in determining whether the patient has an occult bacteremia (e.g. endocarditis), BUT it is in those patients where the growth of coagulase-negative staphylococcus is MOST LIKELY to represent a TRUE infection. Hence the challenge. If endocarditis (or other occult bacteremia) is suspected, consider 3 sets of cultures.

9. In patients with true "Fever of Unknown Origin" or possible endocarditis - let the RN know so they can write FUO or SBE in the comment field for the cultures. The samples will then be grown for 21 days.

Appendix G – Algorithm for treating positive cultures in patients with a central line