

Use of Simulation to Promote Best Practice for Obtaining Blood Cultures

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**PROJECT
FIRSTLINE**

CDC's National Training Collaborative
for Healthcare Infection Prevention & Control



Kentucky Public Health

Prevent. Promote. Protect.

Project Firstline is a national collaborative led by the U.S. Centers for Disease Control and Prevention (CDC) to provide infection control training and education to frontline health care workers and public health personnel. Kentucky Infection Prevention (KyIP) Training Center is proud to partner with Project Firstline to deliver the most up-to-date and best quality infection prevention and control training and information.



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Project Firstline



Project Firstline is a national collaborative led by the U.S. Centers for Disease Control and Prevention (CDC) to provide infection control training and education to frontline healthcare workers and public health personnel. The Kentucky Infection Prevention Training Center is proud to partner with the Kentucky Department of Public Health and Project Firstline. Funding for the Kentucky Infection Prevention Training Center (KyIP) is provided through the Centers for Disease Control and Prevention (CDC) Epidemiology and Laboratory Capacity (ELC) Enhancing Detection grant supplement award to the Kentucky Department for Public Health (KDPH). CDC is an agency within the Department of Health and Human Services (HHS). The contents of this simulation skill packets do not necessarily represent the policies of CDC or HHS and should not be considered an endorsement by the Federal Government

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Objectives

- Define what a blood culture is and how it is used for diagnostic and treatment planning.
- Recognize the impact of blood culture contamination on patients and the healthcare system as a whole.
- Analyze the relationship between blood culture contamination and antibiotic stewardship.
- Apply actions that will prevent blood culture contamination.
- Demonstrate proper method for blood culture collection in regards to technique, volume, and timing.



Risk Recognition

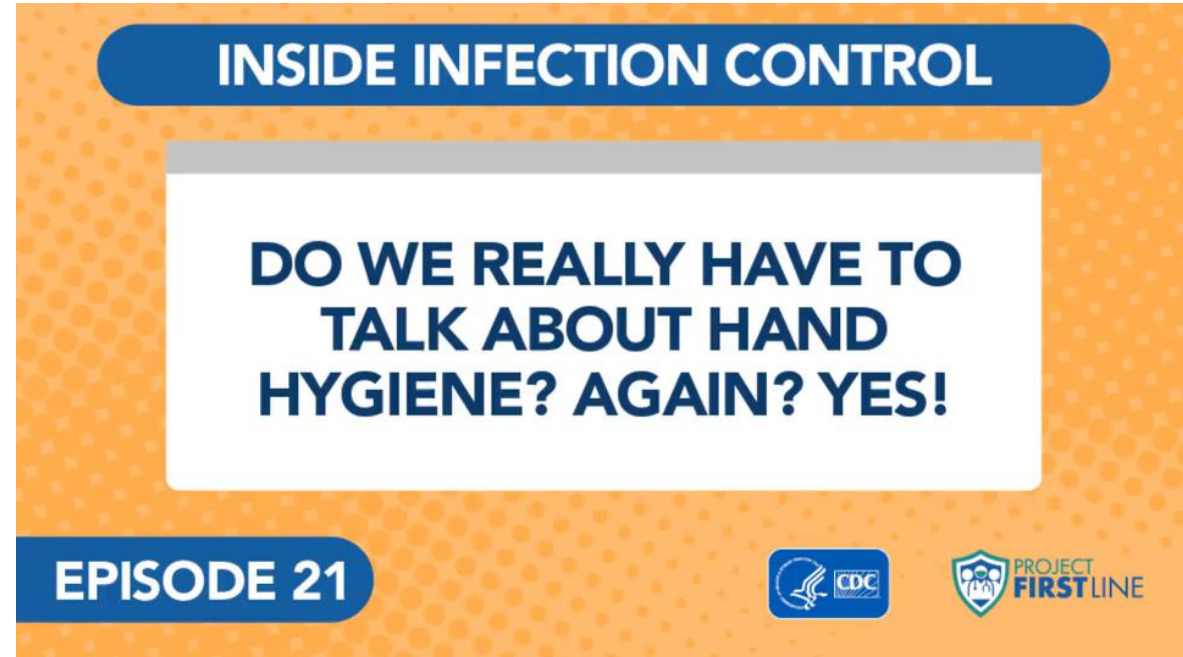


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Pre-Brief (Background)

- Episode 21: Do We Really Have to Talk About Hand Hygiene? Again? Yes!
- Project Firstline, CDC
- Dr. Abby Carlson, MD



Reservoirs

- Where germs can commonly live in and on the body
 - Skin
 - Gut
 - Respiratory
 - Blood



What is a blood culture?

- A sample of blood drawn from the patient that is placed in media and monitored for growth.
- Growth of bacteria could indicate the patient has bacteria in their bloodstream.
 - Contamination of a blood culture could falsely indicate a bloodstream infection
- Blood cultures are important diagnostic tools for patients presenting with signs of bacteremia
- Determining organism type via culture guides treatment and management



How do blood cultures guide patient management?

- If an organism is detected, the most appropriate antibiotic is selected to treat that organism.
- Some organisms are always clinically significant, but others can likely be a blood culture contamination.
- The provider will compare the patient's clinical presentation if a contamination is suspected.

Always clinically significant	Typically contaminant, but should check for clinical correlation
<i>S. aureus</i>	Coagulase-negative staphylococci (except <i>Staphylococcus lugdunensis</i> , this is typically clinically significant)
<i>Streptococcus pneumoniae</i>	<i>Corynebacterium</i> species
Group A <i>Streptococcus</i>	<i>Cutibacterium acnes</i>
Enterobacteriaceae	<i>Bacillus</i> species (except <i>B. anthracis</i> , which is a clinically significant pathogen)
<i>Haemophilus influenzae</i>	<i>Micrococcus</i> species
<i>Pseudomonas aeruginosa</i>	
Bacteroidaceae	
<i>Candida</i> species	

(Doern, 2021)



Impact of Blood Culture Contamination

- Longer hospital stays
- Unnecessary antibiotic use
- Unnecessary antibiotic use can lead to antibiotic resistance



How do blood cultures get contaminated?

- At the time of the venipuncture
 - Inadequate skin antisepsis
- During transfer to the blood culture bottle
 - Inadequate disinfection of rubber diaphragm of blood culture bottle
- Indwelling lines



Germs Live on Skin



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Germs Live on Dry Surfaces



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Prevention of Contamination

- Careful ordering of blood cultures based on appropriate patient selection
- Skin antisepsis with 2% alcoholic chlorhexidine or 70% isopropyl alcohol, followed by 2% chlorhexidine. Allow at least 30 seconds for dry time.
- Disinfect the rubber diaphragm of the blood culture vials with at least 70% isopropyl alcohol.
- Blood cultures should routinely be collected from peripheral sites, not central lines or other intravascular access sites which increase the chance of contamination.
- Generally hand hygiene with clean nonsterile gloves are adequate and recommended. Sterile gloves should be used if re-palpation of the disinfected skin site is necessary.
- Blood culture kits and standard procedures for obtaining cultures have shown in studies to reduce contamination rates.



Prevention of Contamination

- When obtaining multiple labs during one venipuncture, blood cultures should be drawn first to prevent contamination.
- Blood cultures should be drawn directly into blood culture bottles using a butterfly and an adapter whenever possible. This process decreases the risk of blood culture contamination through the transfer process .



Blood Culture Contamination Rates

- American Society for Microbiology (ASM) and Clinical Laboratory Standards Institute (CLSI), blood culture contamination rates should not exceed 3%
- **However, per the CDC, a contamination rate of less than 1% is achievable when best practices are in place. The CDC emphasizes striving for <1%.**
 - Proper hand hygiene
 - Proper skin antisepsis
 - Scrubbing vial diaphragms with alcohol adequately
- Do you know your facility's current contamination rate?



Antibiotic Resistance and Stewardship

- “Clinicians should strive to obtain blood cultures for the right patients, in the right settings, and at the right time,” (CDC, n.d. pg. 2).
- Starting antibiotics without obtaining blood cultures first makes narrowing down antibiotics much harder
- Ordering blood cultures on a patient who has a low likelihood of bacteremia could end up with a false positive result
- Goal of antibiotic stewardship is to reduce the use of antibiotics, therefore reducing resistance



Blood Volume

- In adults obtain 20mls (10ml for aerobic and 10ml for anaerobic) for the most accurate pathogen yield.



Dos and Don'ts of Blood Cultures

Dos	Don'ts



Dos and Don'ts of Blood Cultures

Dos
DO order to determine etiology of infection

Don'ts
DON'T order blood cultures routinely on every patient



Dos and Don'ts of Blood Cultures

Dos	Don'ts
DO order to determine etiology of infection	DON'T order blood cultures routinely on every patient
DO obtain cultures before starting antibiotics	DON'T overfill or under fill blood culture bottles



Dos and Don'ts of Blood Cultures

Dos
DO order to determine etiology of infection
DO obtain cultures before starting antibiotics
DO use proper skin antisepsis technique

Don'ts
DON'T order blood cultures routinely on every patient
DON'T overfill or under fill blood culture bottles
DON'T use alcohol only, scrubbing back and forth



Dos and Don'ts of Blood Cultures

Dos	Don'ts
DO order to determine etiology of infection	DON'T order blood cultures routinely on every patient
DO obtain cultures before starting antibiotics	DON'T overfill or under fill blood culture bottles
DO use proper skin antisepsis technique	DON'T use alcohol only, scrubbing back and forth
DO choose peripheral sites over indwelling lines	DON'T draw from indwelling lines without clinician order



Dos and Don'ts of Blood Cultures

Dos
DO order to determine etiology of infection
DO obtain cultures before starting antibiotics
DO use proper skin antisepsis technique
DO choose peripheral sites over indwelling lines
DO disinfect the rubber diaphragm of the vial

Don'ts
DON'T order blood cultures routinely on every patient
DON'T overfill or under fill blood culture bottles
DON'T use alcohol only, scrubbing back and forth
DON'T draw from indwelling lines with clinician order
DON'T refrigerate or freeze blood cultures



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DO order to determine etiology of infection
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DO disinfect the rubber diaphragm of the vial
DO develop a team for blood culture collection

Don'ts
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DON'T overfill or under fill blood culture bottles
DON'T use alcohol only, scrubbing back and forth
DON'T draw from indwelling lines with clinician order
DON'T refrigerate or freeze blood cultures
DON'T allow your facility contamination rate >1%



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DO develop a team for blood culture collection	DON'T allow your facility contamination rate >1%
DO create a standardized process	DON'T draw multiple blood culture vials (beyond one anaerobic and one aerobic) from the same site



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DO provide surveillance and feedback on contamination rates	DON'T forget to compare potential contaminated organisms to clinical presentation



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DO create a standardized process	DON'T draw multiple blood culture vials (beyond one anaerobic and one aerobic) from the same site
DO provide surveillance and feedback on contamination rates	DON'T forget to compare potential contaminated organisms to clinical presentation
DO draw blood directly into the blood culture bottle using an initial diversion device if available	

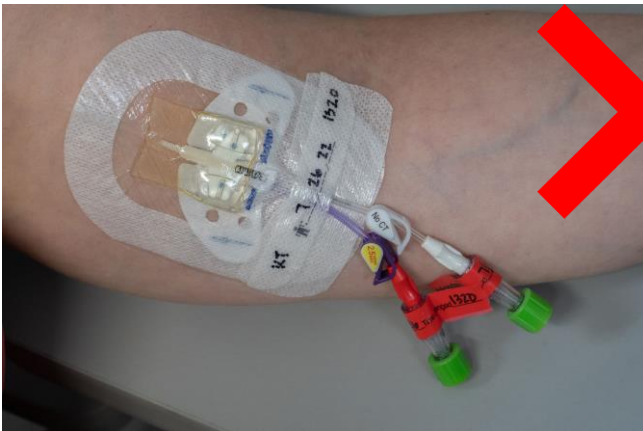
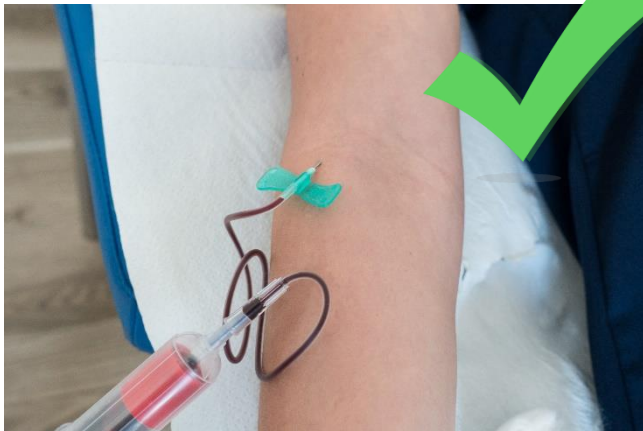


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DO provide surveillance and feedback on contamination rates	DON'T forget to compare potential contaminated organisms to clinical presentation
DO draw blood directly into the blood culture bottle using an initial diversion device if available	
DO obtain adequate blood volume	



Indwelling verse peripheral



- Blood cultures should always be drawn peripherally from a fresh venipuncture. This is best practice.
- Drawing blood cultures off of existing central and peripheral lines can increase the risk of blood culture contamination.
- It is best practice to only draw peripheral cultures unless ordered otherwise by a provider. Sometimes a provider will request cultures be drawn off of a line if a different type of infection is suspected.

Simulation #1: Skin Antisepsis

- Demonstrate obtaining blood cultures from three different sites with proper and improper skin antisepsis to show contamination risks.
- Proper skin antisepsis should consist of a 2% CHG/70% alcohol prep sponge scrub for 30 seconds of back and forth vigorous scrubbing

Click here to
watch



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Simulation #2: Improper Scrubbing Technique

- Demonstrate effects of proper vs improper scrubbing of rubber diaphragm of blood culture bottle
- Best practice is to disinfect the rubber diaphragm of the blood culture vials with 70% alcohol sterile pad. Allow diaphragm to dry before transfer.



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watch



Simulation #2 Activity

1. Blood cultures routinely drawn from peripheral sites.

Proper Technique

Improper Technique

2. Using CHG/alcohol sponge, scrub the venipuncture site using back and forth motions for 30 seconds. Allow site to dry for a minimum of 30 seconds.

Proper Technique

Improper Technique

3. Repalpating the site wearing clean non-sterile gloves after skin antiseptis is performed.

Proper Technique

Improper Technique

4. Obtaining at least 10ml of blood per culture bottle.

Proper Technique

Improper Technique

5. Using 70% isopropyl alcohol pad to disinfect the rubber diaphragm of the blood culture vial and allow to dry.

Proper Technique

Improper Technique

6. Holding on to the end of the syringe as you connect the transfer device to ensure a good connection.

Proper Technique

Improper Technique

7. If unable to get specimen to lab immediately after collection, place in freezer until transport.

Proper Technique

Improper Technique



Simulation #3: Blood Volume

- Visualize proper and improper blood volumes in both syringes and blood culture vials
- Discuss the relationship of blood volume and pathogen growth yield.



Simulation #3: Blood Volume



Simulation #4: Contamination Rates

- **Scenario:** Your facility's blood culture contamination rate is now 5%, which is up from the normal 1% contamination rate the facility usually sees. This contamination rate changed in one month's time. The instructor will test the learner's knowledge on what level of contamination is acceptable.



Simulation #4 Discussion

- The CDC emphasizes with the proper techniques and protocols that a <1% contamination rate is doable.
- Blood culture contamination can result in unnecessary antibiotic use until repeat cultures can grow.
- Obtaining blood cultures before starting antibiotics is key to finding the best antibiotic to treat the pathogen. Starting broad spectrum without cultures can make it difficult to narrow and ultimately increase the risk of antibiotic resistance.
- Knowing the dos and don'ts of blood culture collection will help keep contamination rates down.
- A standardized approach, the use of kits, and a dedicated team of people that draws the blood cultures are all ways to decrease the contamination rate.



Blood Culture Collection-Proper Method

- Steps followed as provided by Elsevier



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De-Brief

- What errors did you identify?
- What is the impact?
- What practices may prevent this issue?
- How far up the chain will you take this?
- How can Human Factors Engineering be applied to this issue?
- What went well?
- What would you change?



De-Brief: Key Take-Home Points

- Hand hygiene is vital to preventing blood culture contamination. Sterile gloves are required if re-palpating the site.
- Skin is a reservoir for germs. Skin antisepsis with 2% alcoholic chlorhexidine or 70% isopropyl alcohol, followed by 2% chlorhexidine can prevent blood culture contamination.
- Disinfect the rubber diaphragm of the blood culture vials with at least 70% isopropyl alcohol.
- Choose peripheral sites for collection over indwelling lines unless instructed by a provider.
- Adequate blood volume is imperative for accurate pathogen yield.
- Contamination rates below 1% can decrease the risk of antibiotic resistance due to unnecessary antibiotic use.



Kentucky Antimicrobial Stewardship Innovation Consortium (KASIC)

- “A free program to address the use of antimicrobials across the Commonwealth in order to optimize clinical outcomes while minimizing adverse consequences of antimicrobial use.”
- Kentucky prescribes antibiotics at one of the highest rates in the country. KASIC wants to change this.
- KASIC offers expert resources for education and mentorship to facilities and organizations dedicated to antibiotic stewardship.



KASIC Office Hours

- Every Thursday from 12:00-1:00pm EST
- Scan the QR code to add to your calendar
- For healthcare professionals to drop in for questions, guidance, or facility concerns.



References

- American Society for Microbiology: Cumitech 1C, 2005 (EJ Baron *et al.*) ASM Press
- Baron EJ, Miller JM, Weinstein MP, Richter SS, Gilligan PH, Thomson RB Jr, Bourbeau P, Carroll KC, Kehl SC, Dunne WM, Robinson-Dunn B, Schwartzman JD, Chapin KC, Snyder JW, Forbes BA, Patel R, Rosenblatt JE, Pritt BS. A guide to utilization of the microbiology laboratory for diagnosis of infectious diseases: 2013 recommendations by the Infectious Diseases Society of America (IDSA) and the American Society for Microbiology (ASM)(a). *Clin Infect Dis*. 2013 Aug;57(4):e22-e121. doi: 10.1093/cid/cit278. Epub 2013 Jul 10. PMID: 23845951; PMCID: PMC3719886.
- Be Antibiotics Aware: Smart Use, Best Care. (2021). CDC. Retrieved from <https://www.cdc.gov/patientsafety/features/be-antibiotics-aware.html#:~:text=When%20antibiotics%20aren%E2%80%99t%20needed%2C%20they%20won%E2%80%99t%20help%20you%2C,Yeast%20infections%20More%20serious%20side%20effects%20can%20include%3A> Accessed on August 4, 2022.
- Best Practices in the Diagnosis and Treatment of Bacteremia. (2019). AHRQ. 17(20)-0028-EF. Retrieved from <https://www.ahrq.gov/antibiotic-use/acute-care/diagnosis/bacteremia.html> Accessed on August 5, 2022.
- Blood Culture Contamination: An Overview for Infection Control and Antibiotic Stewardship Programs Working with the Clinical Laboratory. (n.d). CDC. Retrieved from https://www.cdc.gov/antibiotic-use/core-elements/pdfs/FS-BloodCulture-508.pdf?ACSTrackingID=USCDC_426-DM86188&ACSTrackingLabel=Clinicians%3A%20Use%20this%20guide%20to%20decrease%20blood%20culture%20contamination%20rates&deliveryName=USCDC_426-DM86188. Accessed on July 20, 2022.
- Center for Disease Control and Prevention (CDC). (2022). *Germs Can Live on Dry Surfaces*. CDC. Retrieved from [Germs can live on dry surfaces \(cdc.gov\)](https://www.cdc.gov/germs-can-live-on-dry-surfaces). Accessed January 20, 2023.
- Clinical and Laboratory Standards Institute (CLSI®), document M47-A, Vol 27, 2007 (ML Wilson *et al.*)
- Cox, K. (n.d.) Blood Sampling from a Central Venous Catheter. *Elsevier*. Procedure 62. [0071-ch0062-9780323376624.indd \(elsevier.com\)](https://www.elsevier.com/locate/S0071-0062(97)80323376624)



References

- Doern GV, Carroll KC, Diekema DJ, Garey KW, Rupp ME, Weinstein MP, Sexton DJ. 2019. A comprehensive update on the problem of blood culture contamination and a discussion of methods for addressing the problem. *Clin Microbiol Rev* 33:e00009-19. <https://doi.org/10.1128/CMR.00009-19>
- Doern, G.V. (May 3, 2021). Detection of bacteremia: Blood cultures and other diagnostic tests. *UpToDate*. https://www.uptodate.com/contents/detection-of-bacteremia-blood-cultures-and-other-diagnostic-tests?search=blood%20culture%20procedure&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1. Accessed on May 19, 2022.
- Emergency Nurses Association (ENA). Clinical Practice Guideline: Prevention of Blood Culture Contamination. March 14, 2022. <https://www.guidelinecentral.com/guideline/308349/> Accessed on May 19, 2022.
- Hospital Toolkit for Adult Sepsis Surveillance. (2018). CDC. Retrieved from https://www.cdc.gov/sepsis/pdfs/Sepsis-Surveillance-Toolkit-Mar-2018_508.pdf
- Kirn, T.J., Weinstein, M.P. (2013). Update on blood cultures: how to obtain, process, report, and interpret. *Clinical Microbiology and Infection*. 19(6). 513-520. <https://www.sciencedirect.com/science/article/pii/S1198743X14615093#:~:text=Blood%20cultures%20entered%20into%20automated%2C%20continuous-monitoring%20protocols,should%20routinely%20be%20incubated%20for%205%20days>.
- Magadia, R., Weinstein, M. P. Laboratory Diagnosis of Bacteremia and Fungemia. (2001). *Infectious Disease Clinics of North America*. 15:1 (1009-1024). Retrieved from <https://www.sciencedirect.com/science/article/pii/S0891552005701847?via%3Dihub> Accessed on July 28, 2022.
- Mathew, Alice MSN, RN, CRNI; Gaslin, Tracey PhD, RN, CPNP, CRNI®; Dunning, Kari PhD, PT; Ying, Jun PhD. Central Catheter Blood Sampling: The Impact of Changing the Needleless Caps Prior to Collection. *Journal of Infusion Nursing*: July 2009 - Volume 32 - Issue 4 - p 212-218 doi: 10.1097/NAN.0b013e3181aac20c



References

- Minami, K., Yamada, T., Yoshioka, K., Kawanishi, F., Ogawa, T. & Ukimura, A. (2022). Effect of the introduction of a management bundle for blood culture collection. *AJIC: American Journal of Infection Control*, 50(7). 772-776. <https://doi.org/10.1016/j.ajic.2021.11.019>
- Order of Blood Draw Tubes and Additives. (2019). *CLSI*. <https://clsi.org/about/blog/order-of-blood-draw-tubes-and-additives/>
- Patel, K., Carval, T., Poojary, A., & Poojary, R. (2019). Impact of novel blood culture collection bundle to reduce blood culture contamination rates: An important continuous quality improvement indicator of laboratory medicine. *Journal of Patient Safety and Infection Control*, 7(3), 65.
- Pien BC, Sundaram P, Raoof N, Costa SF, Mirrett S, Woods CW, Reller LB, Weinstein MP. The clinical and prognostic importance of positive blood cultures in adults. *Am J Med*. 2010 Sep;123(9):819-28. doi: 10.1016/j.amjmed.2010.03.021. PMID: 20800151.
- Procop, G. W., Nelson, S. K., Blond, B. J., Souers, R. J., & Massie, L. W. (2020). The Impact of Transit Times on the Detection of Bacterial Pathogens in Blood Cultures: A College of American Pathologists Q-Probes Study of 36 Institutions. *Archives of Pathology & Laboratory Medicine*, 144(5), 564–571. <https://doi.org/10.5858/arpa.2019-0258-CP>
- Tenderenda, A., Łysakowska, M., Dargiewicz, R., & Gawron-Skarbek, A. (2022). Blood Culture Contamination: A Single General Hospital Experience of 2-Year Retrospective Study. *International Journal of Environmental Research and Public Health*, 19(5). <https://doi.org/10.3390/ijerph19053009>





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