

Spine



Prevention



infectionconsensus2018@gmail.com

- For any corrections, comments, edits, etc. please email the above address
- The same comments can be posted on the contact page of our website

lcmphilly.com

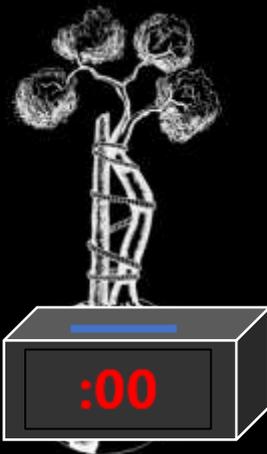
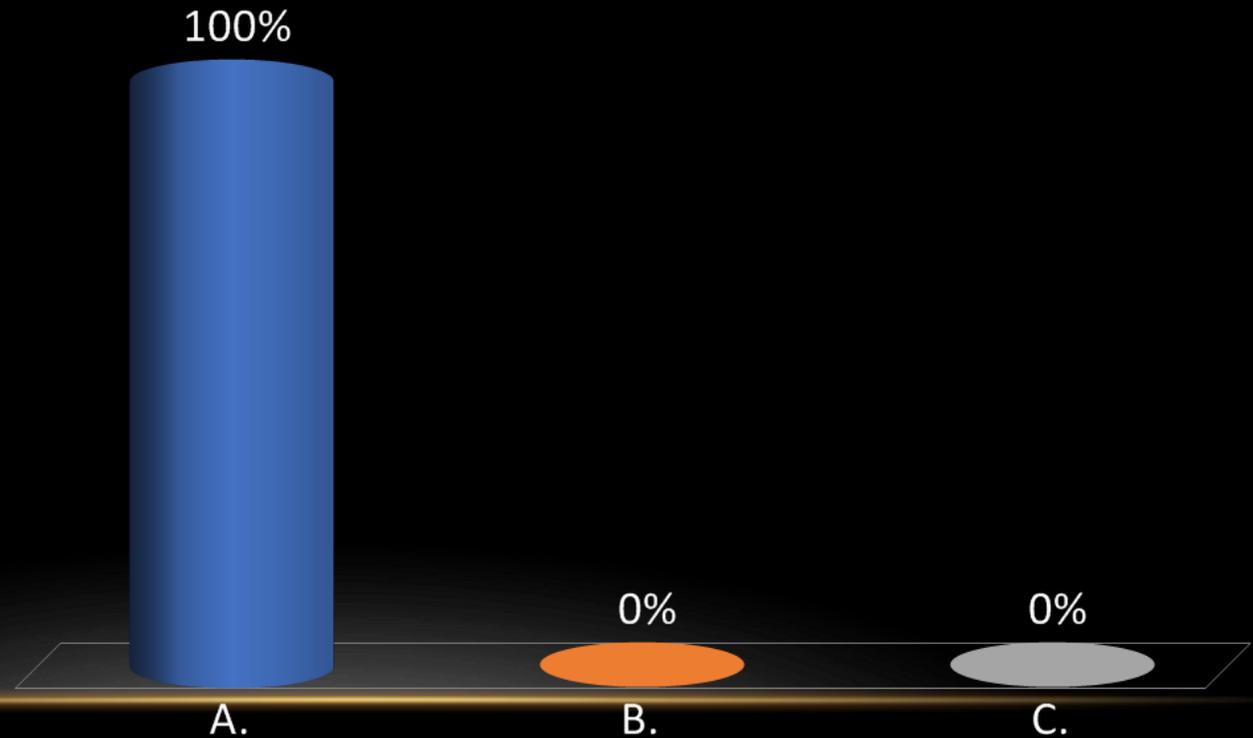


Let's test our devices

A. Yes

B. No

C. Abstain



Spin-1 (Former Spin-5) Does prior or active tuberculosis preclude patients from undergoing spine surgery?

RESEARCHED BY:

Koji Yamada MD, Japan



Literature:

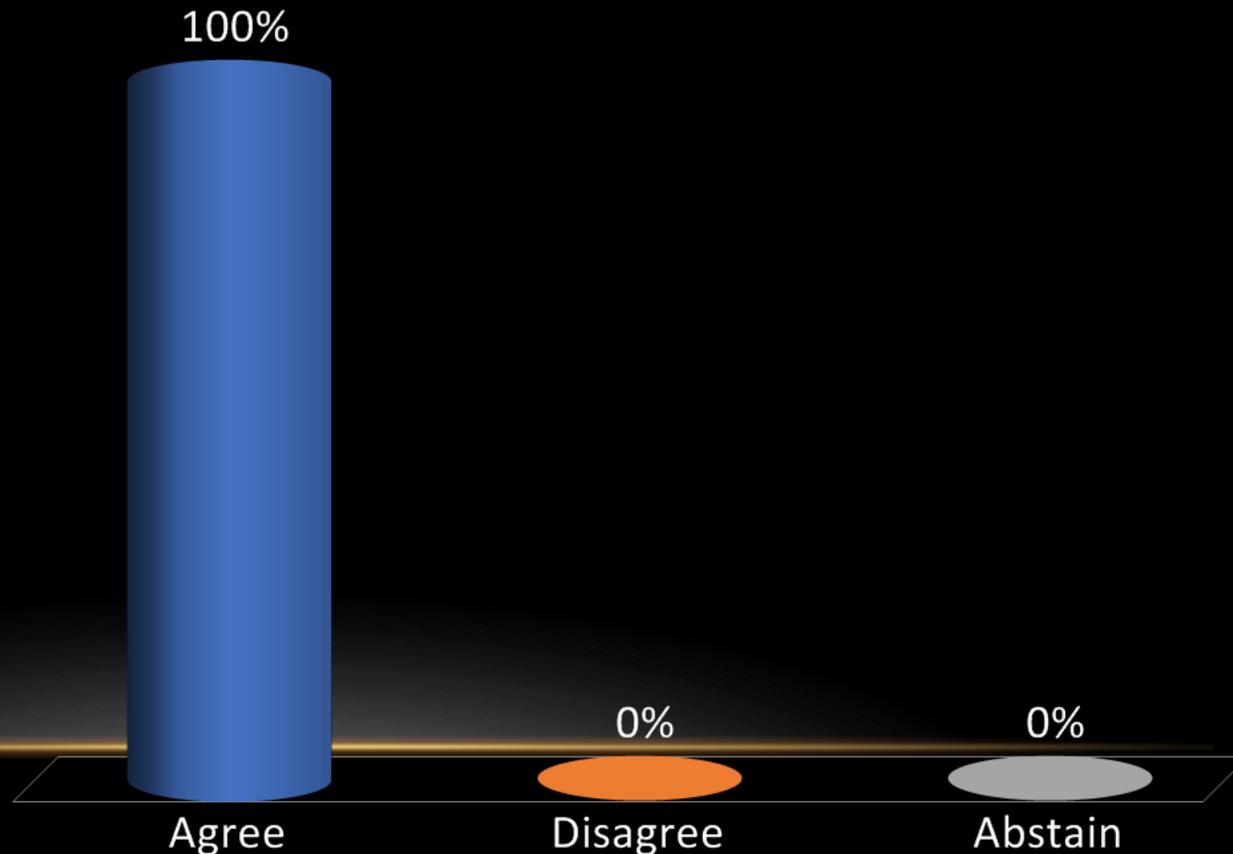
- **Meta analysis: 2, Prospective/Randomized: 3**
- **Limited data with one Cochrane review and another meta-analysis evaluating only two low quality RCTs and one prospective study.**
- **Currently there is no evidence to hinder tuberculosis patients from undergoing spine surgery.**



Recommendation: Prior or active tuberculosis does not preclude patients from undergoing spine surgery.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-2 (Former Spin-41) Should routine MRSA screening be in place prior to spine surgery?

RESEARCHED BY:

Carles Pigrau MD, Spain



Literature:

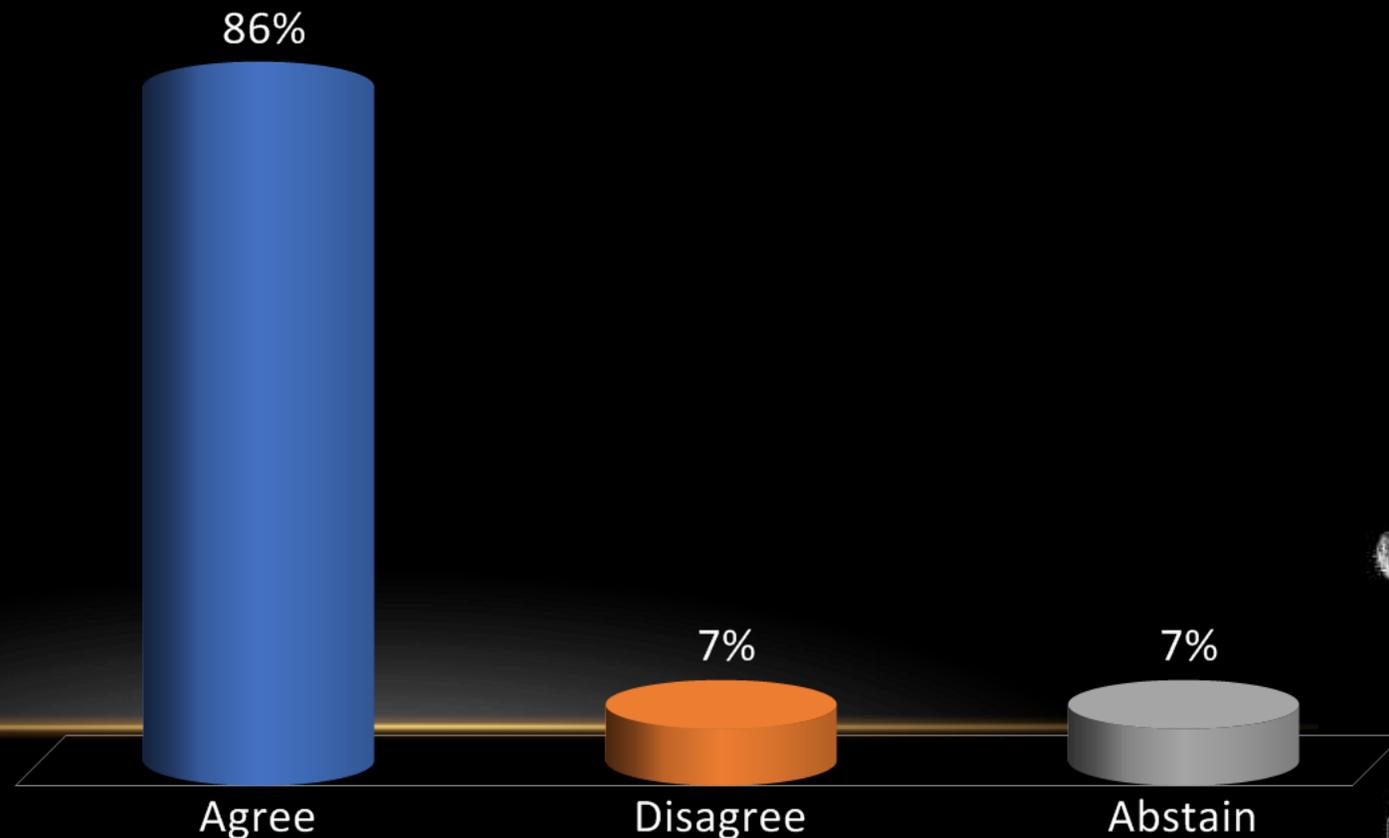
- **Meta analysis: 2, Prospective/Randomized: 0, Retrospective: 2**
- **There is conflicting evidence in the literature regarding routine MRSA screening and more prospective, randomized studies are needed to confirm this recommendation**



Recommendation: No routine MRSA screening should be performed prior to spine surgery. In patients with high risk factors and hospitals with a high incidence of *S. aureus* spinal SSI, and particularly high rates of MRSA infections, MRSA screening might be useful.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-3 (Former Spin-28) Is there a role for routine decolonization of patients undergoing spine surgery? If so, what is the optimal agent(s)?

RESEARCHED BY:



Alexander Vaccaro MD, USA



Barrett Boody MD, USA



Literature:

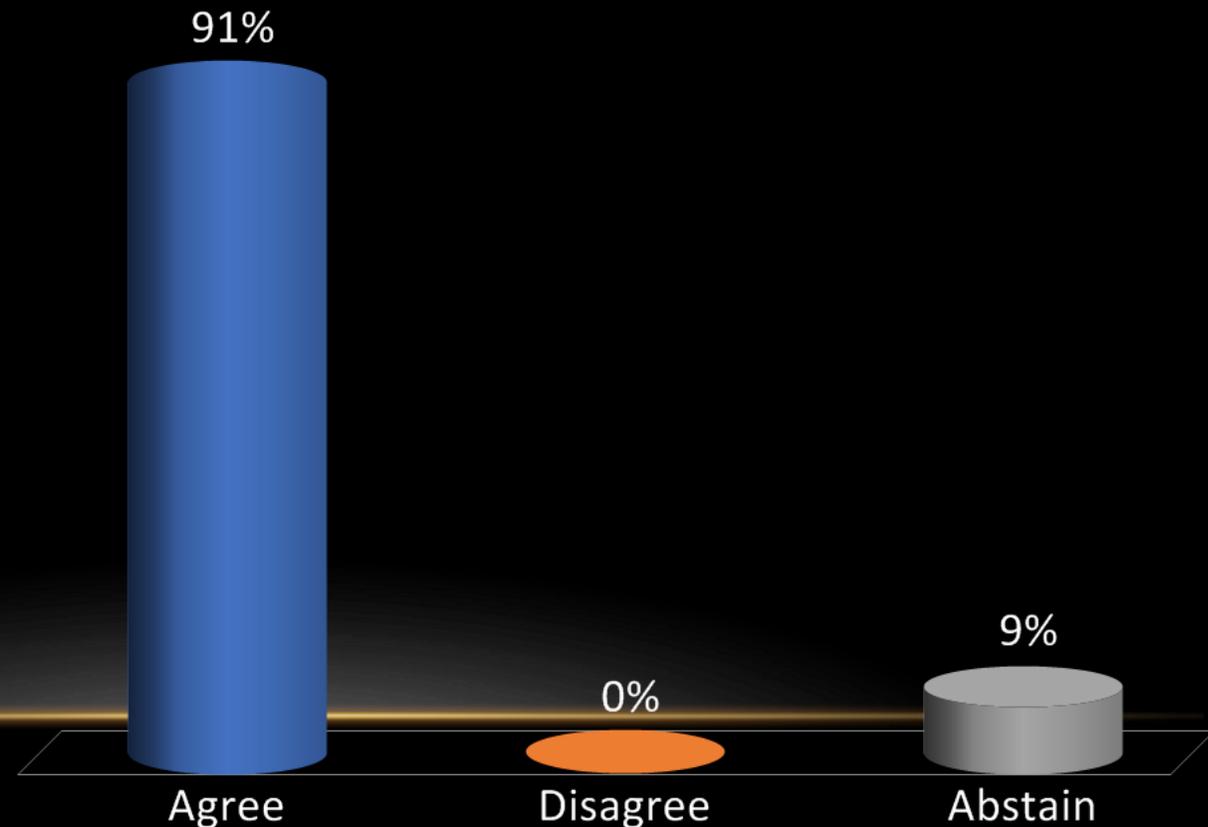
- **Meta analysis/systematic review : 3, Randomized: 1**
- **Current evidence supports the implementation of decolonization protocols in order to reduce the rate of SSIs.**
- **Currently, however, there is no evidence to support the superiority of one decolonization agent over any others.**



Recommendation: There is evidence to support the use of decolonization programs in MRSA carriers to reduce the rate of SSI, however the optimum agents for decolonization has not been determined.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-4 (Former Spin-35) Should all patients with psoas abscesses be screened for both spine and hip infections?

RESEARCHED BY:



Claus Simpfendorfer MD, USA



Pouya Alijanipour MD, Iran



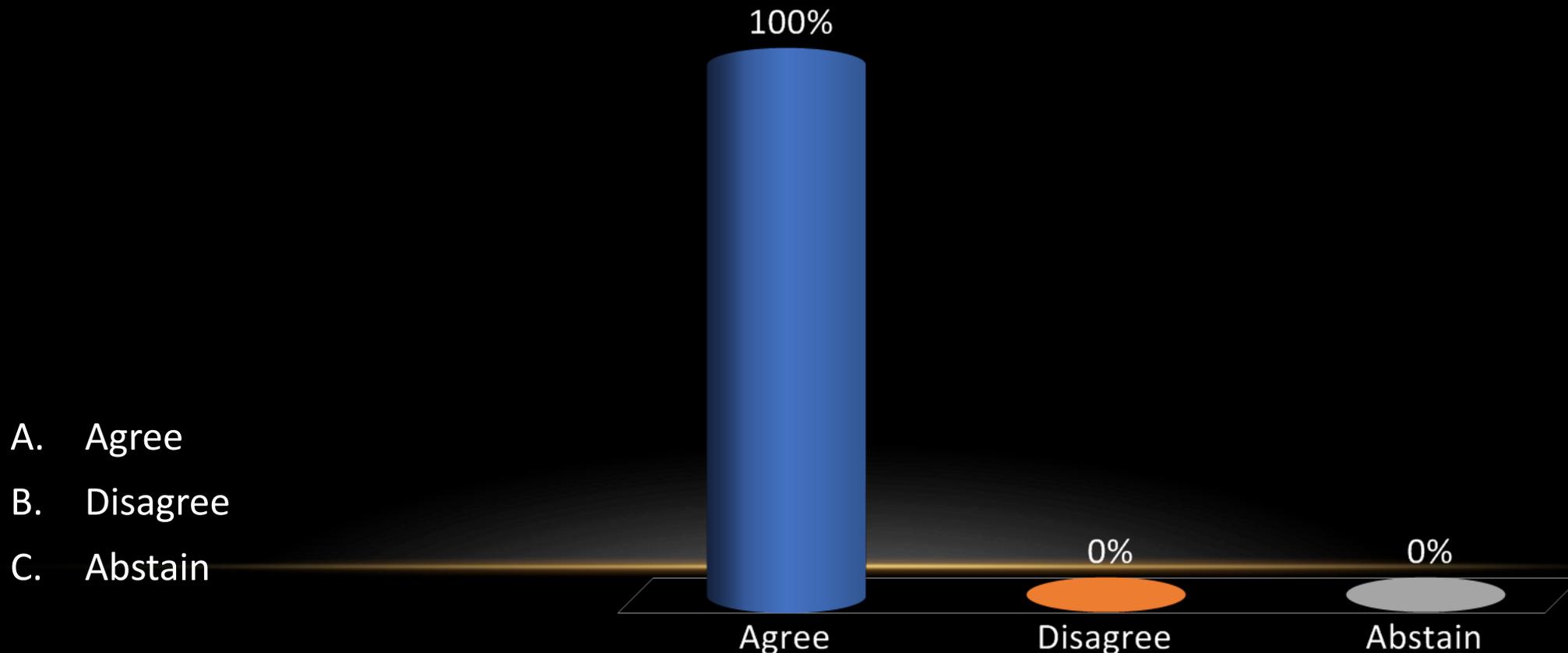
Literature:

- **Meta analysis: 0, Prospective/Randomized: 0, Retrospective: 3**
- **There is limited high level evidence supporting the screening of patients with psoas abscesses for both spine and hip infections.**
- **Current evidence is based primarily on retrospective studies and case-series reports.**



Recommendation: Cross-sectional imaging with CT or MRI will identify the source of secondary psoas abscesses in the majority of cases. If no source is identified, consider cross-sectional imaging with CT or MRI both hip and spine in the setting of a psoas abscess.

Level of Evidence: Limited



Spin-5 (Former Spin-12) How should patients currently using DMARDs be managed in the perioperative period?

RESEARCHED BY:



Taolin Fang MD, USA



Literature:

- **Meta analysis: 1, Prospective/Randomized: 0, Retrospective: 8**
- **There is no current recommendations for the optimal management of patients on DMARDs due to lack of evidence. What is available consists either of expert opinions or low-quality evidence.**



Recommendation: (1) For nonbiologic disease-modifying antirheumatic drugs (DMARDs), such as methotrexate (MTX), leflunomide, hydroxychloroquine, and/or sulfasalazine, continuation of the current dose throughout the perioperative period is recommended.

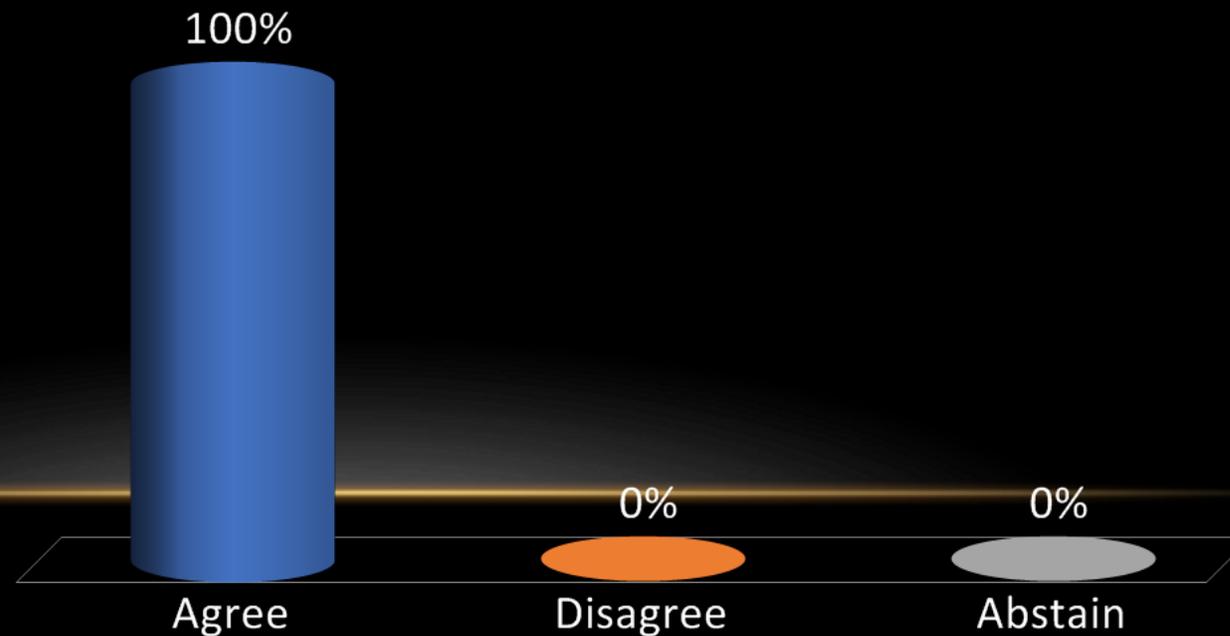
(2) For Biologic DMARDs, such as etanercept, we recommend that physicians withhold the biologic medication and plan elective surgery at the end of the dosing cycle for that specific medication. As an example, patients taking weekly dose should schedule the surgery in the second week after the first withheld dose. These agents should not be restarted until external wound healing is complete, which is typically around two weeks.

Exception: In patients taking tofacitinib (twice daily dose), withhold of tofacitinib for at least one week prior to surgery is recommended.

(3) Medications typically used for SLE patients, such as mycophenolate mofetil, azathioprine, cyclosporine, and tacrolimus, the decision to withhold medications prior to surgery should be made on an individual basis.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Spin-6 (Former Spin-26) Is there a role for oral antibiotics in the prevention of infection in patients with draining wounds following spinal surgery?

RESEARCHED BY:



Alexander Montgomery MD, UK



Literature:

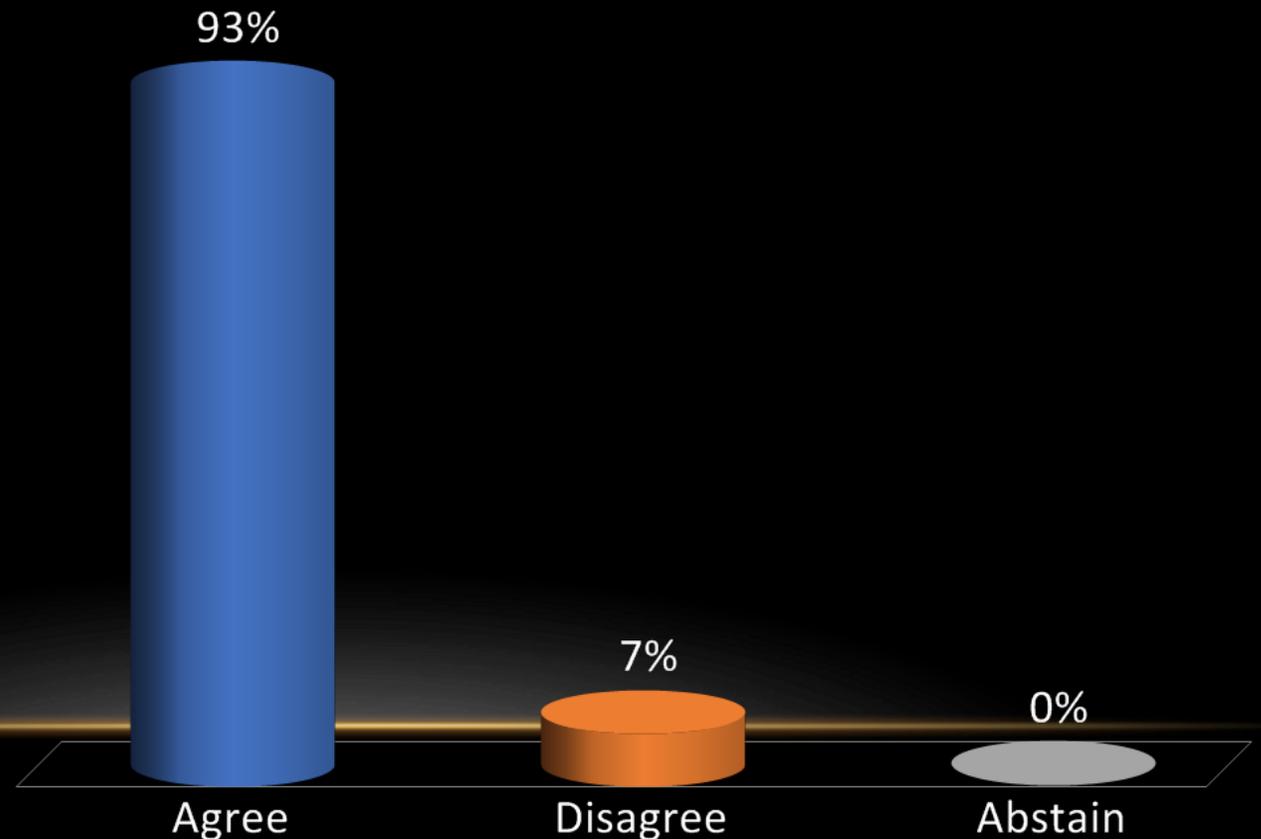
- **Meta analysis: 2, Prospective/Randomized: 1, Retrospective: 1**
- **Current literature does not provide any conclusive evidence regarding the role for oral antibiotics in spinal surgery patients with draining wounds.**



Recommendation: There is no reliable evidence for the use of prophylactic oral antibiotic therapy in patients with draining wounds after spine surgery.

Level of Evidence: Consensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-7 (Former Spin-29) Is there a role for the addition of gentamicin to perioperative prophylactic antibiotics in spine surgery?

RESEARCHED BY:



Robert Sawyer MD, USA



Literature:

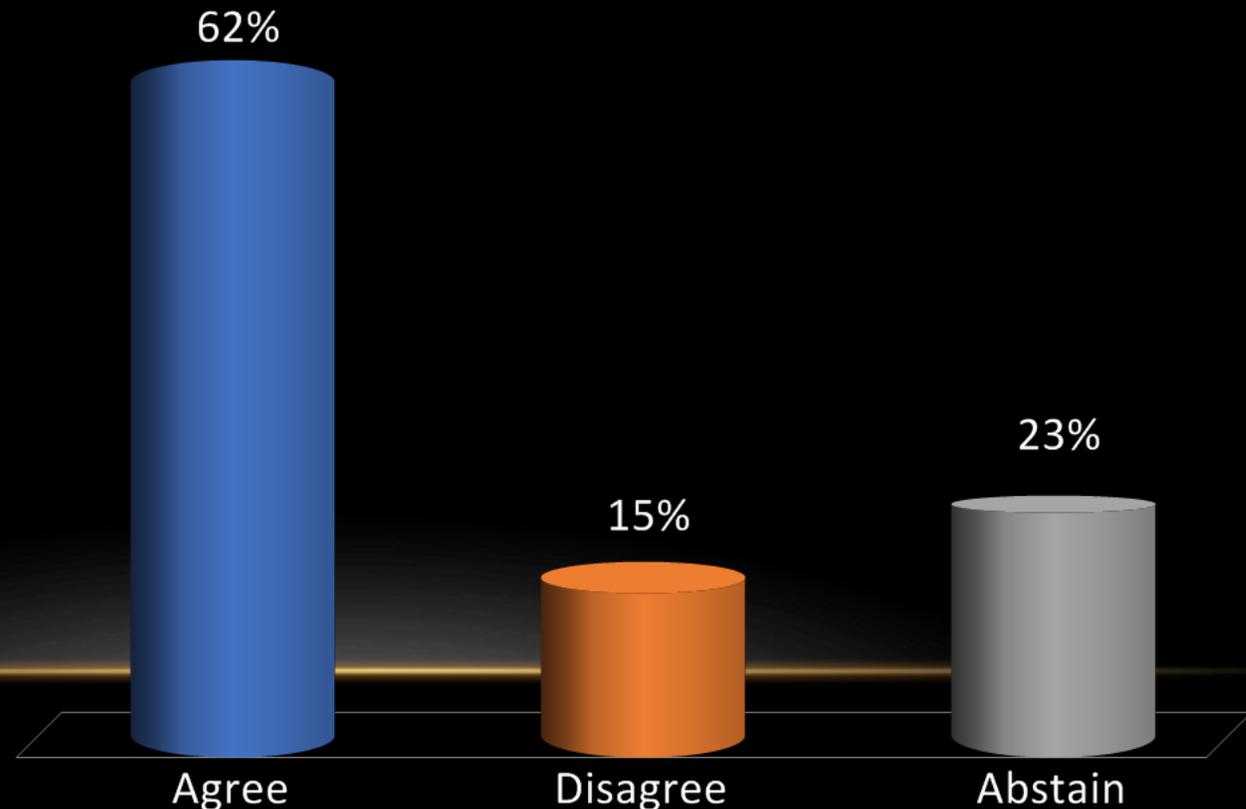
- **Meta analysis: 2, Prospective/Randomized: 2, Retrospective: 4**
- **Strong high quality evidence is present in the literature showing that addition of gentamicin gives no added benefit in the perioperative period.**



Recommendation: No, we recommend AGAINST the inclusion of gentamicin for perioperative prophylaxis in spine surgery. There is no data suggesting the addition of gentamicin to systemic perioperative prophylactic antibiotic regimens decreases the rate of post-operative infections, and strong evidence showed that it is associated with harm, namely nephrotoxicity. The question of the use of local/topical gentamicin is unresolved.

Level of Evidence: Strong

- A. Agree
- B. Disagree
- C. Abstain



Spin-8 (Former Spin-40) Should prophylactic antibiotic prophylaxis be repeated during spine surgery? If so, when?

RESEARCHED BY:



Yvonne Achermann MD, Switzerland



Gregory Schroeder MD, USA



Literature:

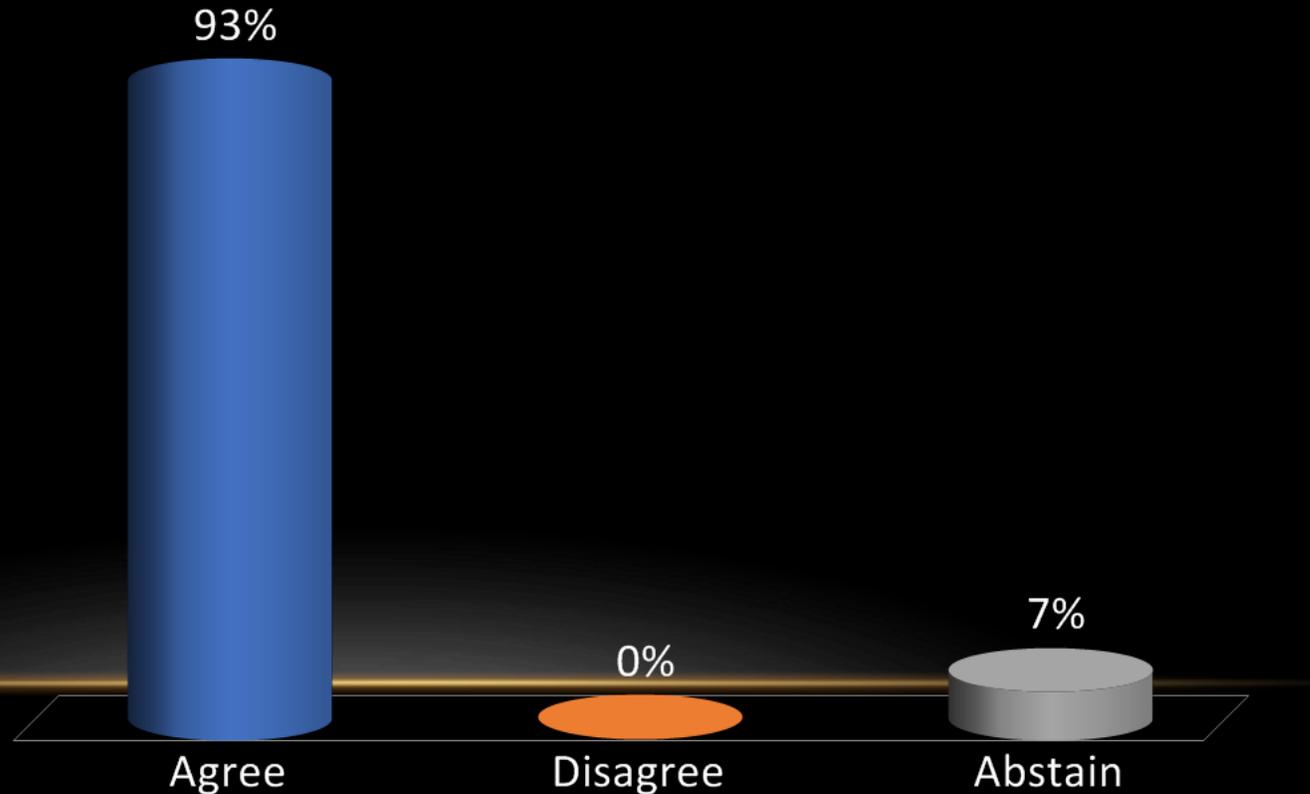
- **There is a lack of evidence to support repeated antibiotic prophylaxis dosing during spine surgery.**



Recommendation: In most uncomplicated spinal procedures, a single preoperative dose of prophylactic antibiotics is sufficient. Prophylactic antibiotics should be redosed intraoperatively for procedures lasting longer than twice the half-life of the antibiotic or if there is excessive blood loss (blood loss > 1,500 mL) in order to ensure that therapeutic levels.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-9 (Former Spin-42) Should vancomycin powder be applied to the wound in patients undergoing spinal surgeries? Are there any potential harms associated with this practice?

RESEARCHED BY:



Steven Schmitt MD, USA



Christopher Kepler MD, USA



Literature:

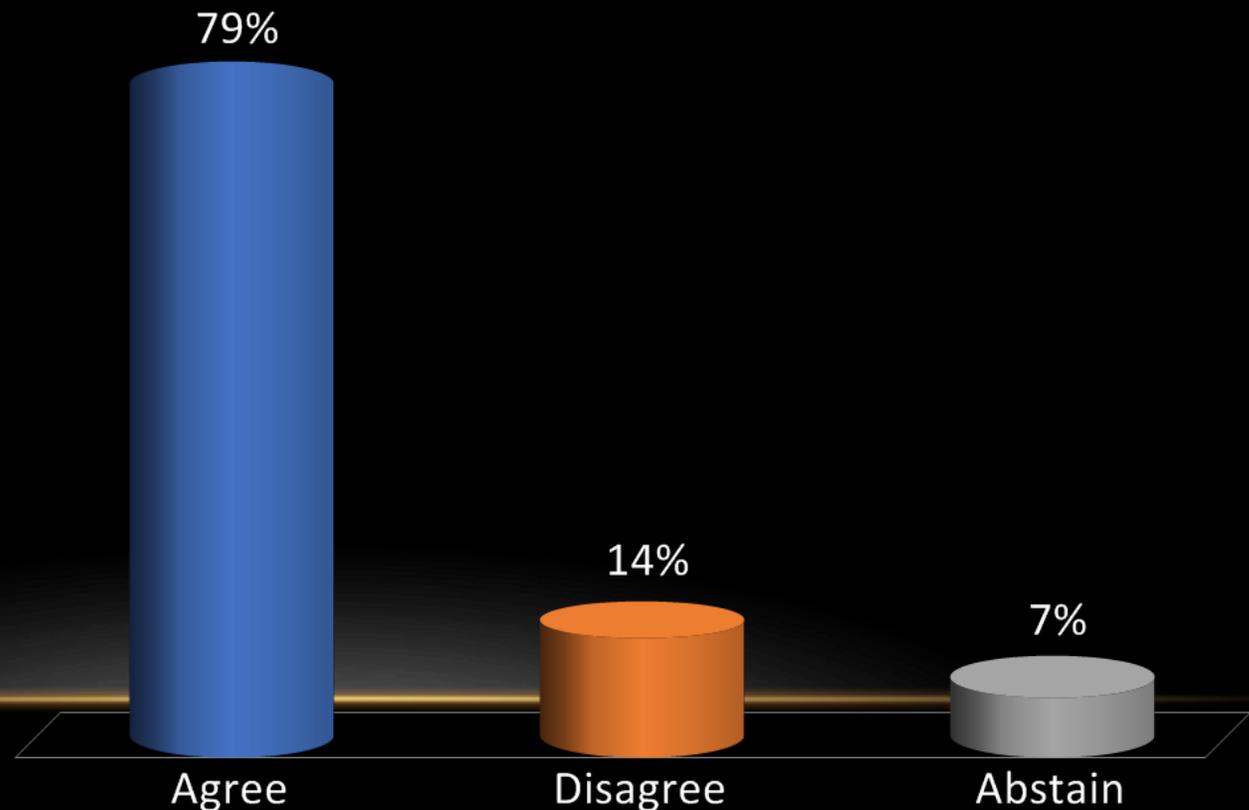
- **There is little to no evidence in the literature regarding the use of vancomycin powder in spinal surgery and any associated harms.**



Recommendation: Yes. Evidence suggests that vancomycin powder applied to the wound during spinal surgery reduces the risk of infection. However, majority of studies lack a control arm and it is not known if vancomycin powder is better than antiseptic agents. There is insufficient evidence for or against the potential harm associated with this practice.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-10 (Former Spin-56) What is the optimal perioperative antibiotic prophylaxis for patients undergoing spine surgery? What considerations should be made in cases of drug allergies?

RESEARCHED BY:



Yvonne Achermann MD, Switzerland



John Koerner MD, USA



Literature:

- **Meta analysis/ systematic review: 6, Prospective/Randomized: 0,**
- **Moderate high-quality evidence exists in the form of multiple systematic reviews and meta-analyses. However, most major studies incorporated in the reviews lack a control arm or comparative agent.**

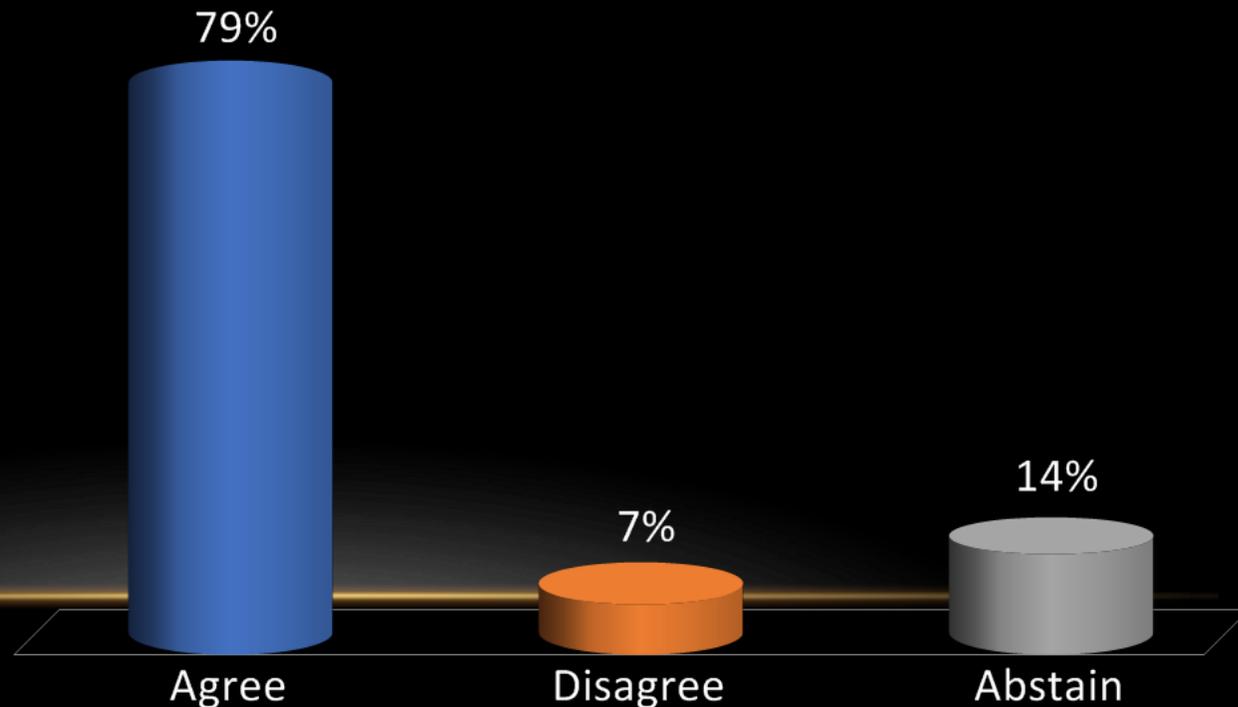


Recommendation: The optimal prophylactic antibiotic for an uncomplicated spine surgery is a first- or second-generation cephalosporin given intravenously within 60 minutes of incision.

In patients with a history of anaphylactic reaction after use of beta lactams or in countries with a high rate of methicillin resistant staphylococcal infections, Vancomycin in a weight-adjusted dose (15mg/kg) should be used. Clindamycin 600mg intravenously is an alternative to Vancomycin.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Spin-11 (Former Spin-57) What is the optimal prophylactic antibiotics for patients with neurogenic bladder undergoing spine surgery?

RESEARCHED BY:



Dolors Rodriguez-Pardo MD, Spain



Literature:

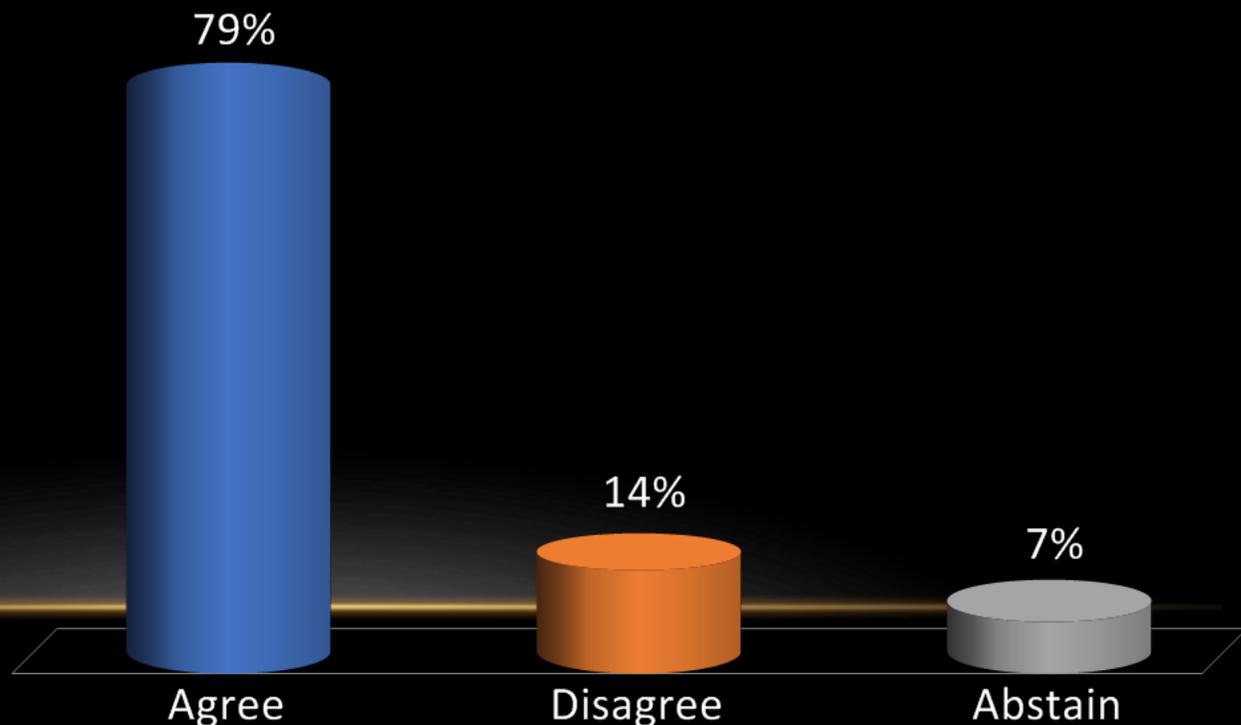
- **No current literature addresses optimal antibiotic choices for patients with neurogenic bladder. Current recommendations are based off expert opinions and retrospective observations.**



Recommendation: The recommended standard perioperative antibiotic prophylaxis in spine surgery is cefazolin but broader-spectrum prophylaxis may be necessary in patient subpopulations more prone to acquiring Surgical Site Infections (SSI). In the case of neurogenic bladder, preoperative urine culture and individualized antibiotic prophylaxis are associated with a significant decrease in SSIs due to Gram-negative bacilli (GNB).

Level of Evidence: Concensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-12 (Former Spin-6) Does the use of allograft increase the risk of spinal infection?

RESEARCHED BY:



Steven Schmitt MD, USA



Christopher Kepler MD, USA



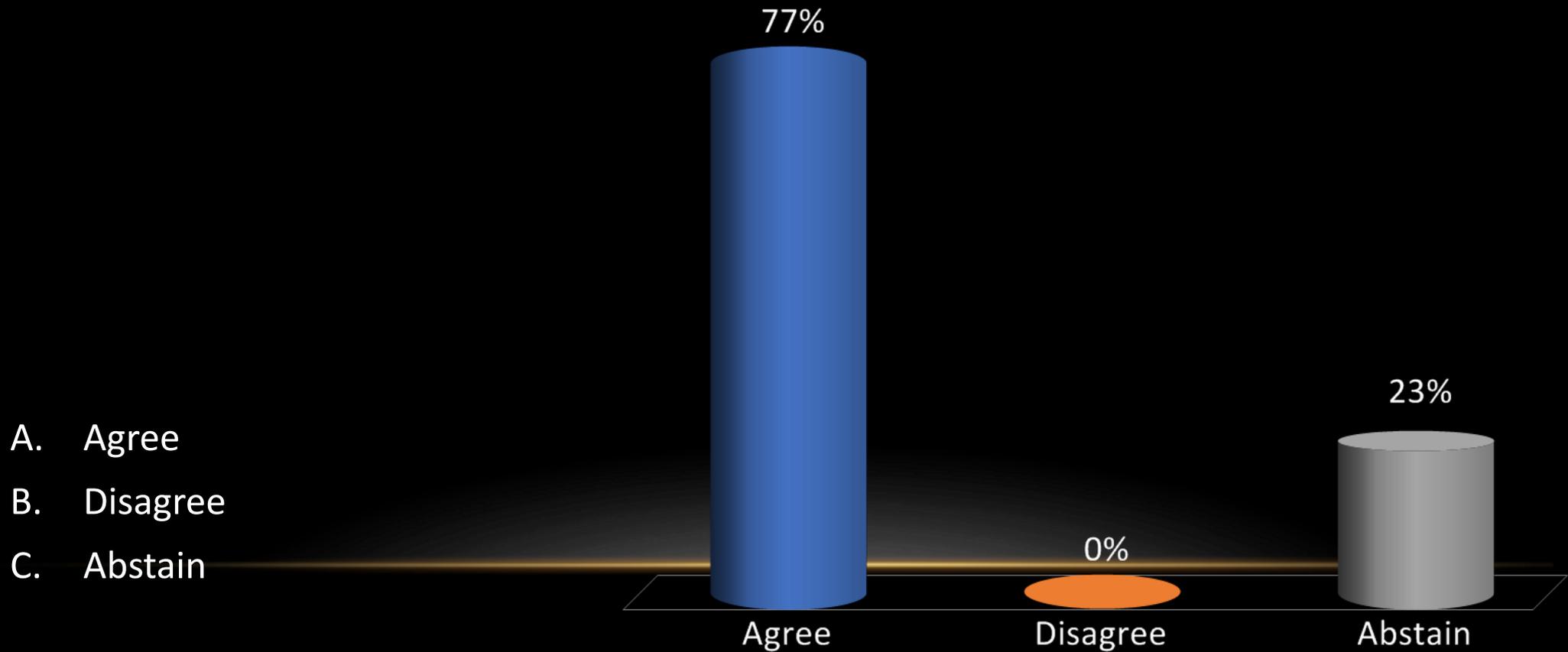
Literature:

- **Meta analysis: 3, Prospective/Randomized: 1, Retrospective: 1**
- **Moderate level evidence in the form of meta-analyses purport that allograft increases risk of spinal infection in the pediatric and neuromuscular populations. However the same levels of evidence show no risk in the adult degenerative populations.**



Recommendation: The use of allograft seems to increase the risk for infection in pediatric and neuromuscular scoliosis; however, there is no increased risk in the adult degenerative population.

Level of Evidence: Moderate



Spin-13 (Former Spin-16) Is negative pressure wound therapy safe on spinal wounds in patients with a CSF leak?

RESEARCHED BY:

Carles Pigrau MD, Spain



Literature:

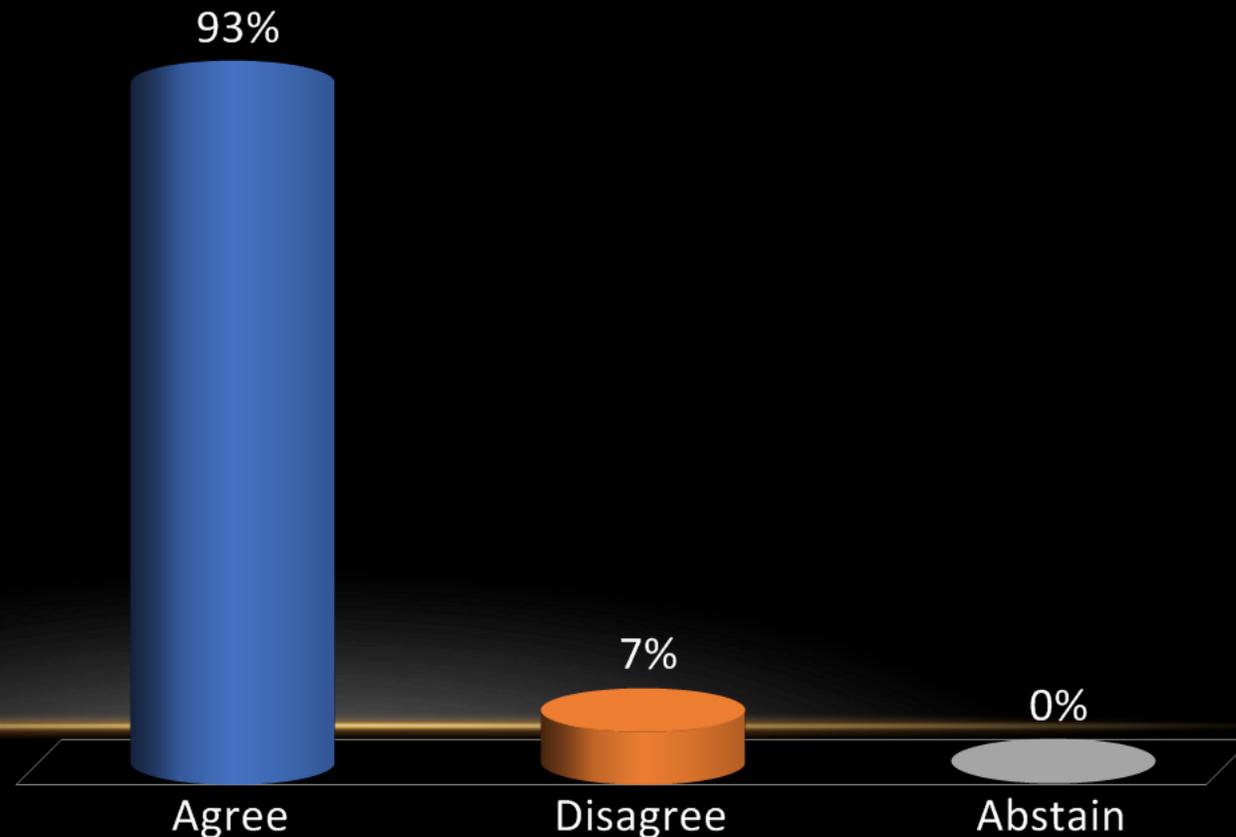
- **Meta analysis: 1, Prospective/Randomized: 0**
- **Evidence reporting the potential harm of negative pressure wound dressing in spinal wounds is limited currently.**



Recommendation: Negative pressure wound therapy may be harmful in patients with a CSF leak, leading to severe neurological sequelae.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-14 (Former Spin-46) What are the risks and benefits for the use of Vac assisted devices/PICO dressings following spine surgery?

RESEARCHED BY:



Barrett Boody MD, USA



Literature:

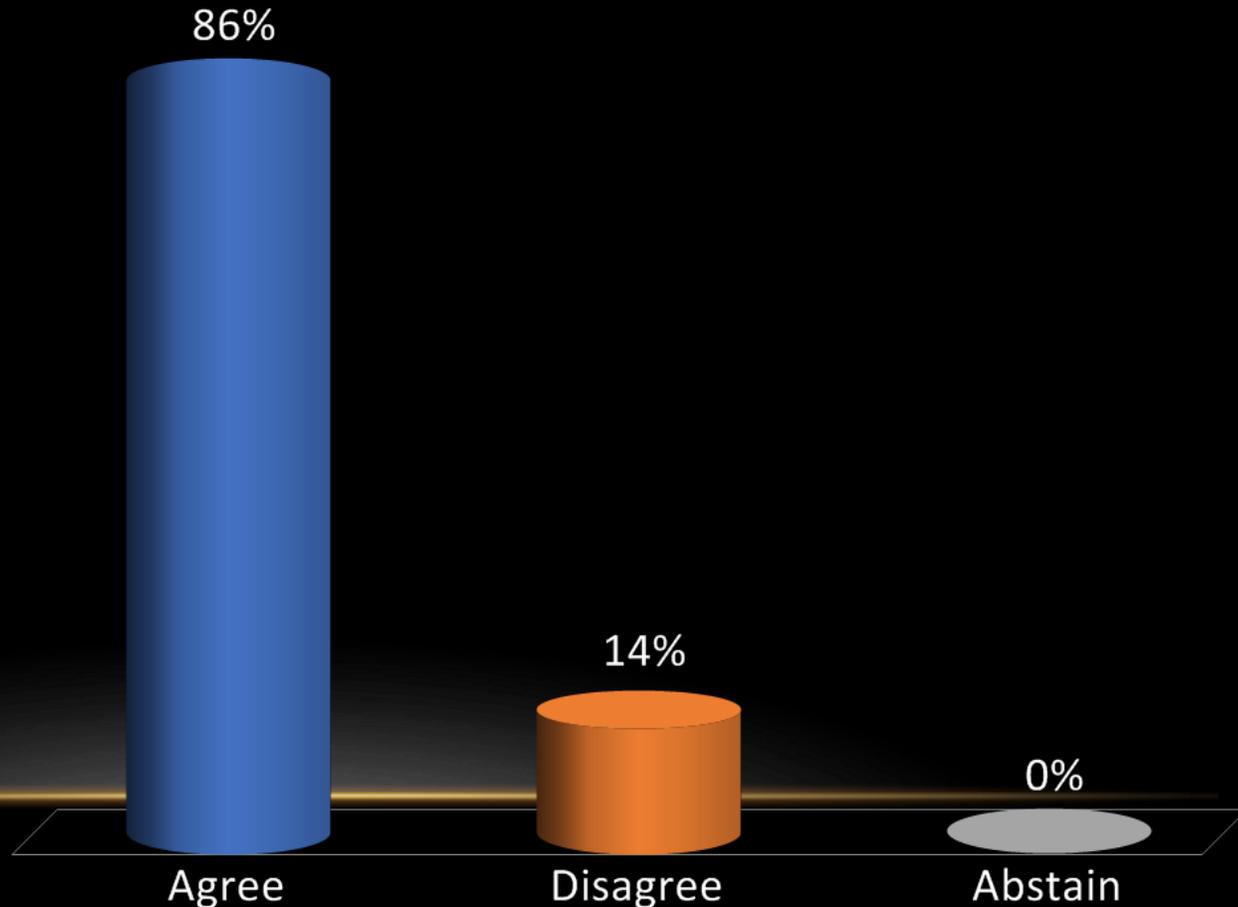
- **Limited high level evidence is available to report on the risks vs. benefits of VAC assisted devices following spine surgery**



Recommendation: The use of incisional VAC therapy (such as PICO dressings) is limited, but available literature supports its use in the prevention of dehiscence and SSI in posterior thoracolumbar deformity surgery.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-15 (Former Spin-59) What should the strategy be if an inadvertent contamination during instrumented spine surgery occurs?

RESEARCHED BY:



Steven Schmitt MD, USA



Christopher Kepler MD, USA



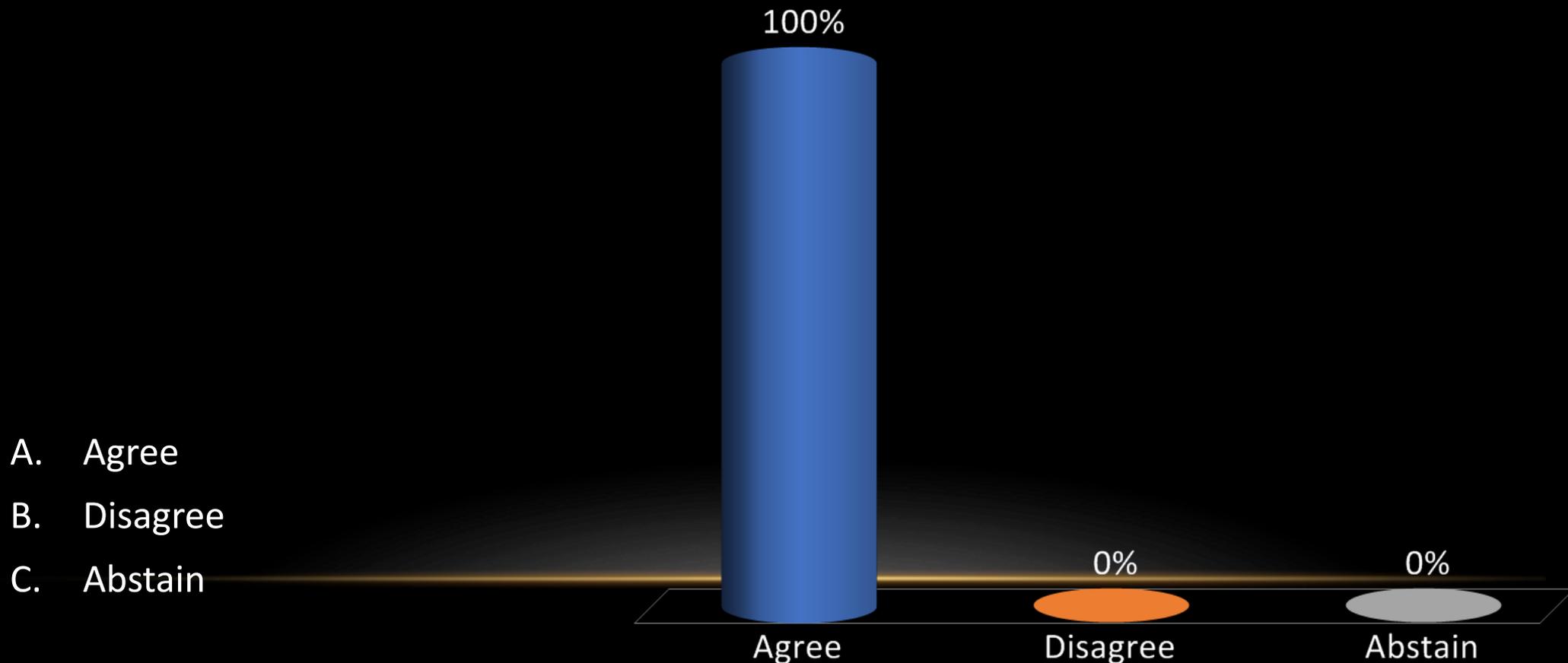
Literature:

- **No data exists in the current literature supporting any method of contamination prevention**



Recommendation: There is no data to support a particular strategy in preventing infection after inadvertent contamination of spinal implants.

Level of Evidence: Consensus



Spin-16 (Former Spin-61) What type of surgical dressing is most effective for lowering rates of surgical site infection (SSI) in patients undergoing spine surgery?

RESEARCHED BY:



Jeffery Rihn MD, USA

Anand Segar MD, USA



Literature:

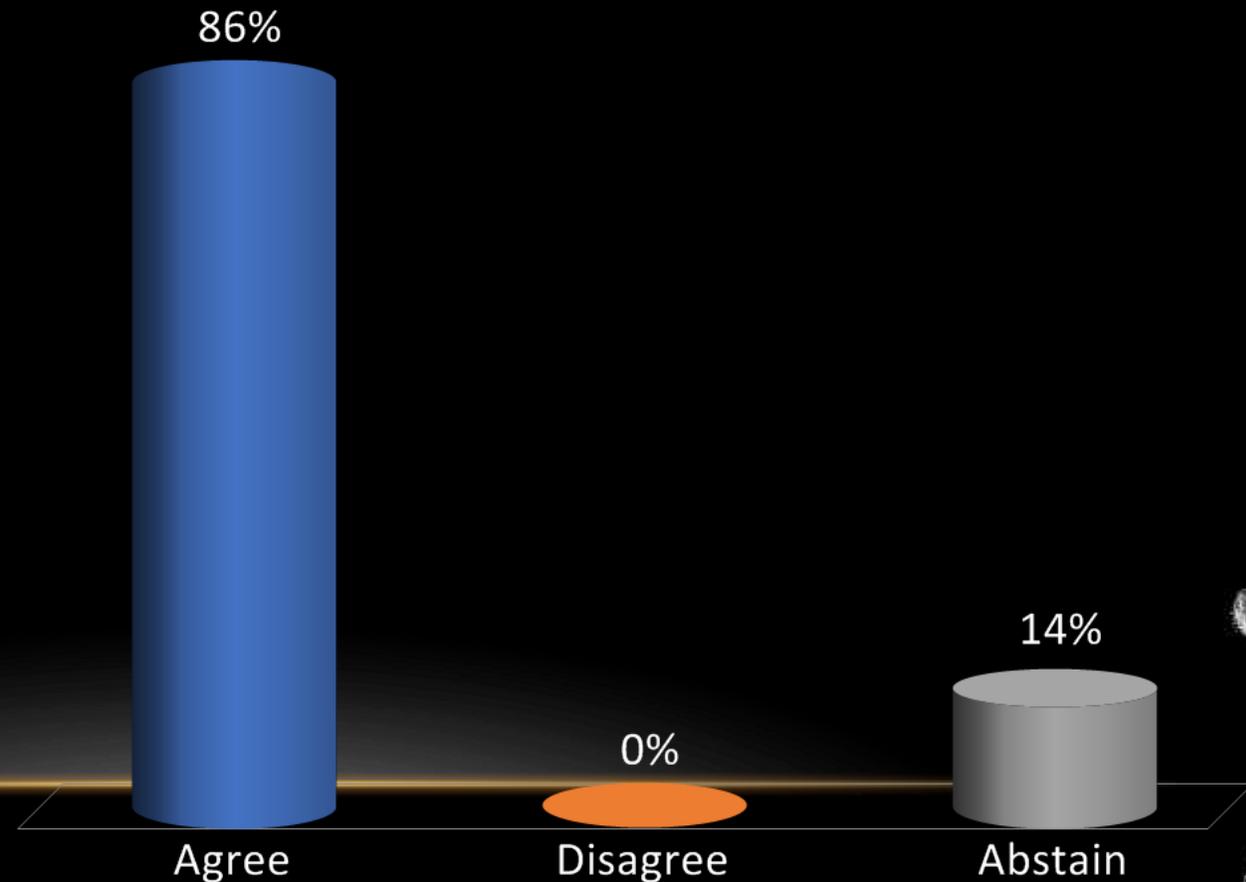
- **Meta analysis: 1, Prospective/Randomized: 1, Retrospective 1**
- **i. Current literature contains very little high-quality evidence in support of any type of surgical dressing for decreasing SSI rates.**



Recommendation: There are no randomized studies comparing the use of incisional negative pressure wound therapy (iNPWT) to standard dry dressings in spine surgery. WHO recommends the use of iNPWT for high risk surgical wounds to reduce the risk of SSI.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-17 (Former Spin-13) How should patients with postoperative diarrhea following spine surgery be managed?

RESEARCHED BY:



Maja Babic MD, USA



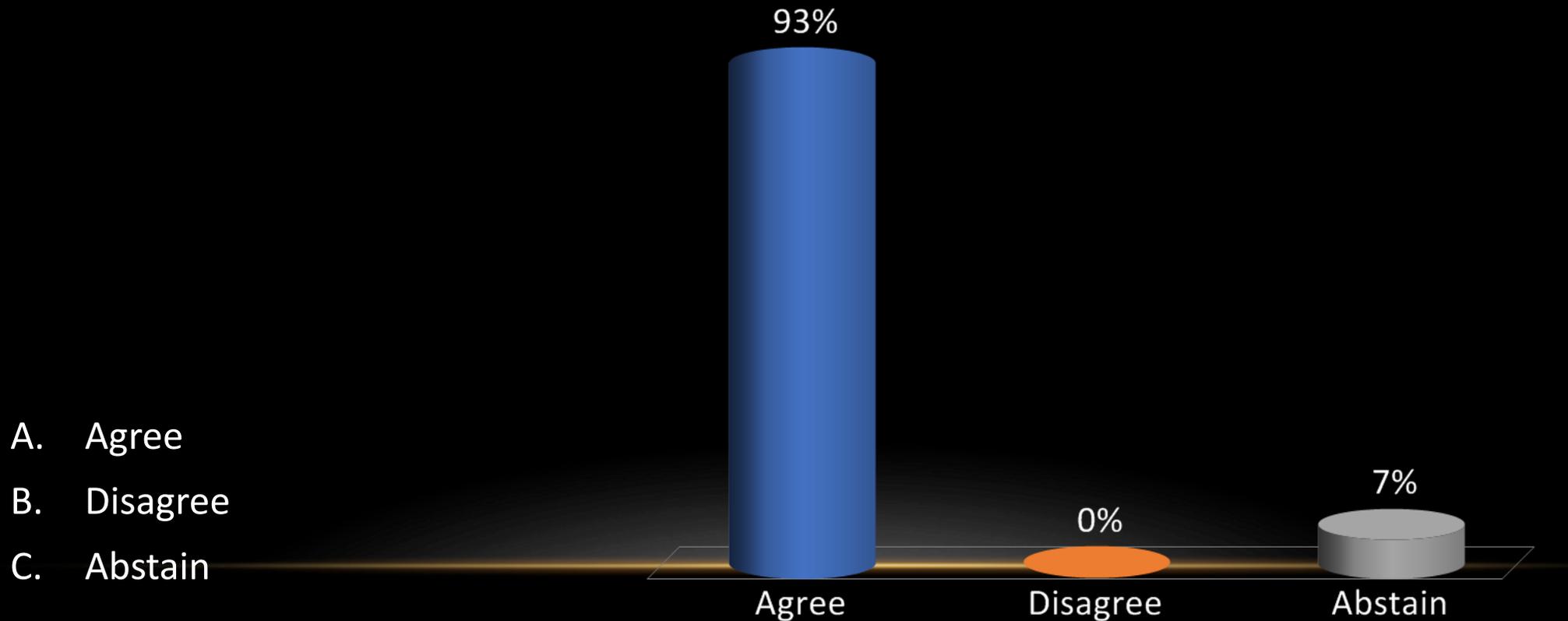
Literature:

- **There is no evidence in the literature supporting any management protocols for postoperative diarrhea in spine surgery.**



Recommendation: Diarrhea can be managed in a standard approach with careful attention to the surgical site.

Level of Evidence: Consensus



Spin-18 (Former Spin-17) Is postoperative hyperglycemia a risk factor for the development of infection following spinal surgery?

RESEARCHED BY:

Koji Yamada MD, Japan



Literature:

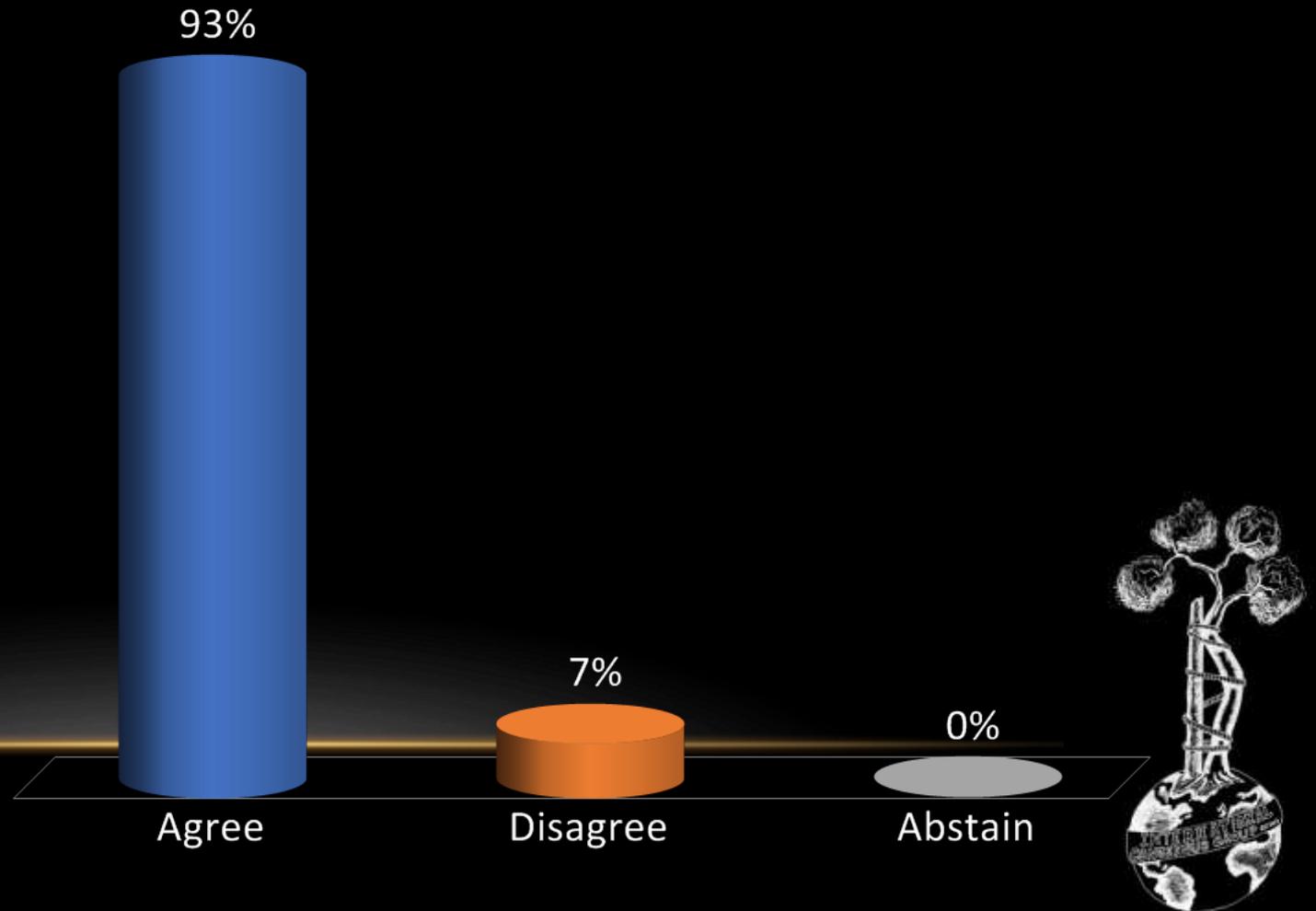
- **Meta analysis: 0, Prospective/Randomized: 2, Retrospective 4**
- **Limited evidence supports the relationship of hyperglycemia and SSI but does not definitively associate the two.**



Recommendation: From the limited evidence, the association between postoperative hyperglycemia and SSI remains unclear, and further study is needed for this issue.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-19 (Former Spin-32) Is there an association between UTI and SSI following spinal surgery?

RESEARCHED BY:



Steven Schmitt MD, USA



Christopher Kepler MD, USA



Literature:

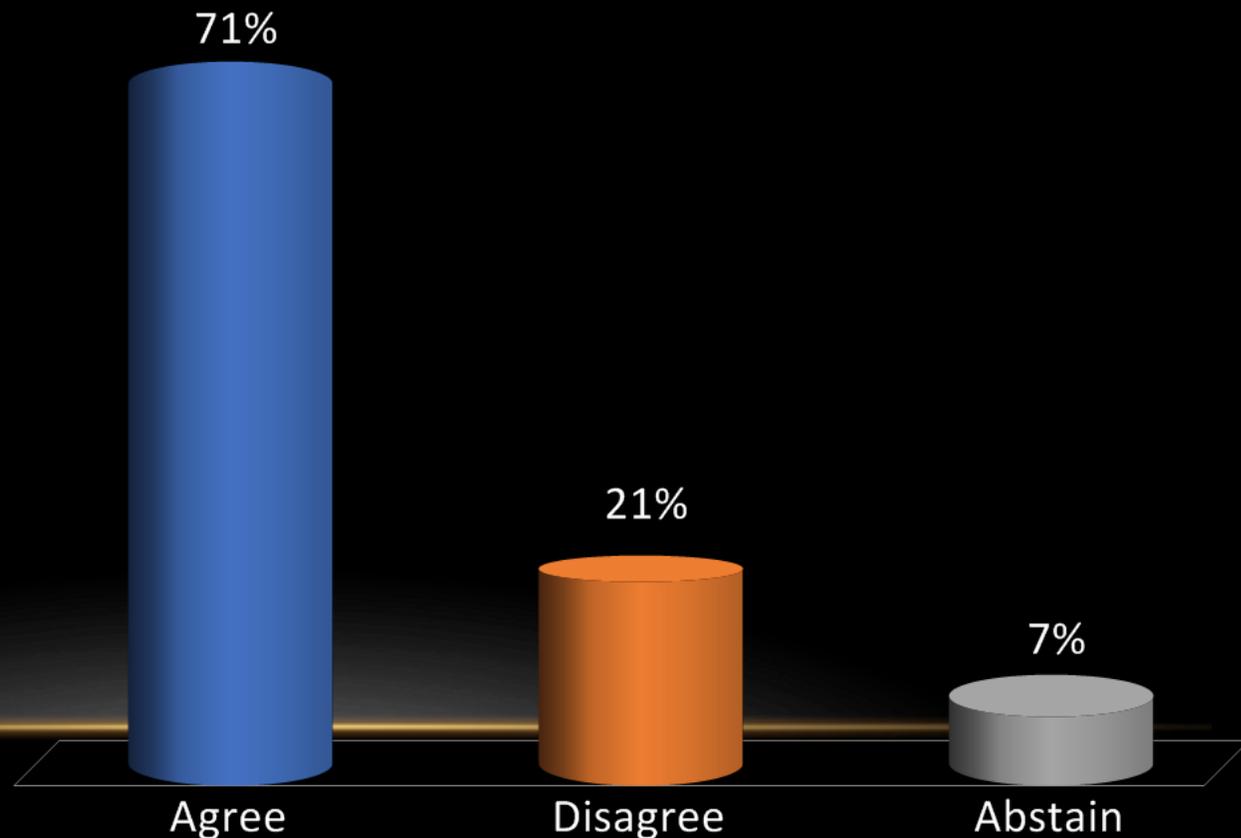
- **Meta analysis: 1, Prospective/Randomized: 0, Retrospective 2**
- **Evidence is conflicting regarding the association between UTI and SSI and further study is needed to elucidate any causal relationship.**



Recommendation: Evidence regarding an association between UTI and SSI following spine surgery is conflicting, and no convincing relationship has been proven. In a like fashion, no convincing relationship has been established between asymptomatic bacteriuria and surgical site infection following spine surgery.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-20 (Former Spin-45) What are the risk factors predisposing a patient to SSI after spine surgery?

RESEARCHED BY:



Alexander Montgomery MD, UK



Literature:

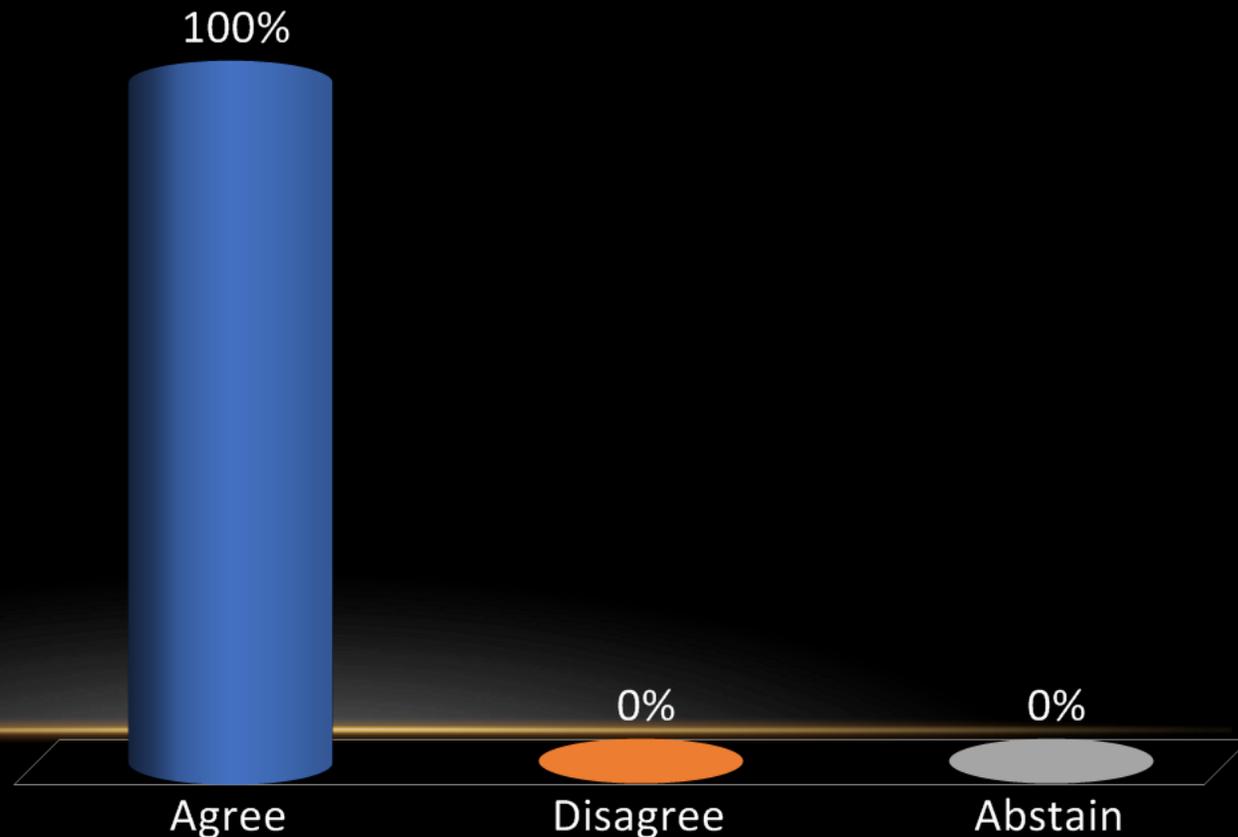
- **Meta analysis: 2, Prospective/Randomized: 2**
- **Moderate evidence from the literature supports identification of several risk factors for SSI after spine surgery however more prospective studies are needed to validate them.**



Recommendation: Numerous risk factors for surgical site infections (SSI) following spine surgery have been identified, including diabetes, obesity, prior SSI, smoking, longer operative times, posterior approach to spine, and the number of levels fused.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Spin-21 (Former Spin-3) Can allograft or synthetic bone substitute or autograft be used during revision spinal surgery in patients with clinically resolved spine infection?

RESEARCHED BY:



Steven Schmitt MD, USA



Christopher Kepler MD, USA



Literature:

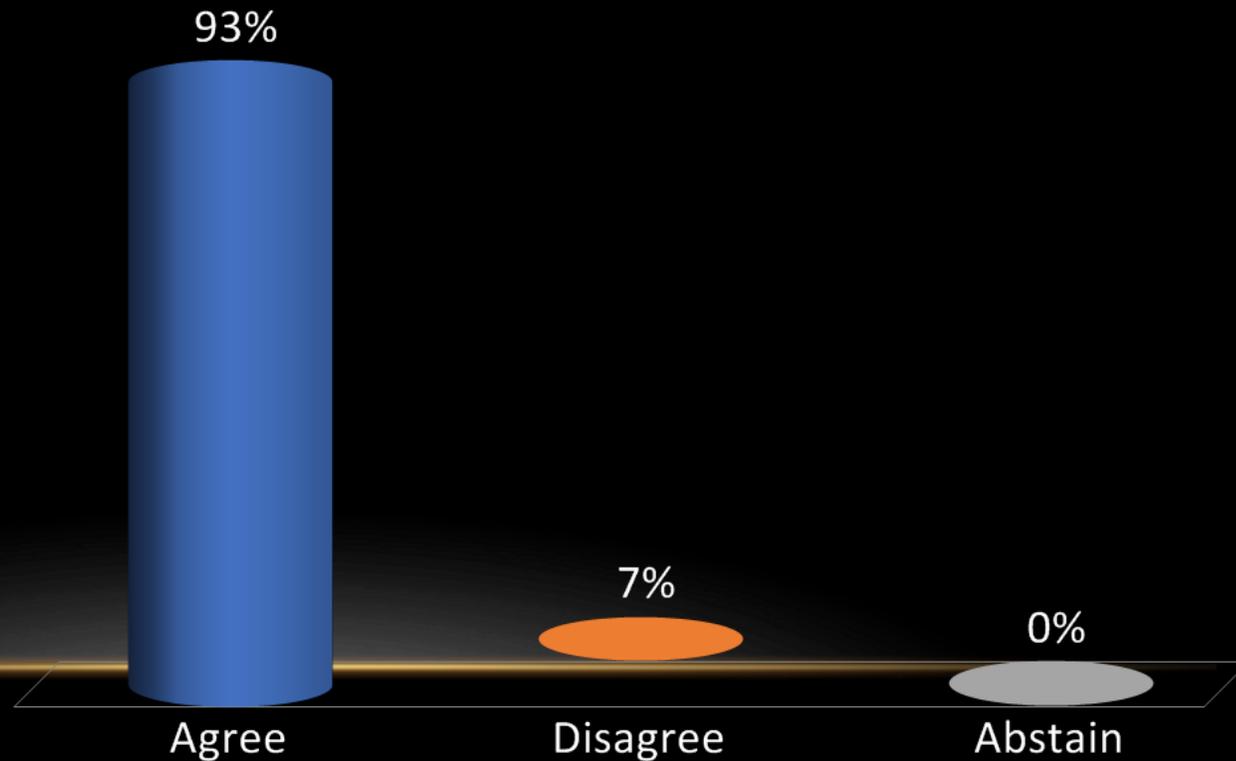
- **Meta analysis: 1, Prospective/Randomized: 1, Retrospective 6**
- **Moderate level evidence is apparent through multiple retrospective studies as well as a meta-analysis supporting the use of allograft, autograft and synthetic cages in revision spinal surgery.**



Recommendation: Based on available data, it appears that allograft, autograft, and synthetic cages may be used successfully along with posterior screw fixation and prolonged antibiotic therapy in the treatment of pyogenic spondylodiscitis. This data can probably be extrapolated to also confirm that allograft and autograft is safe during revision spinal surgery with prior infection.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Diagnostic



Spin-22 (Former Spin-49) What is the definition of surgical site infection in spinal surgery?

RESEARCHED BY:



Robert Sawyer MD, USA



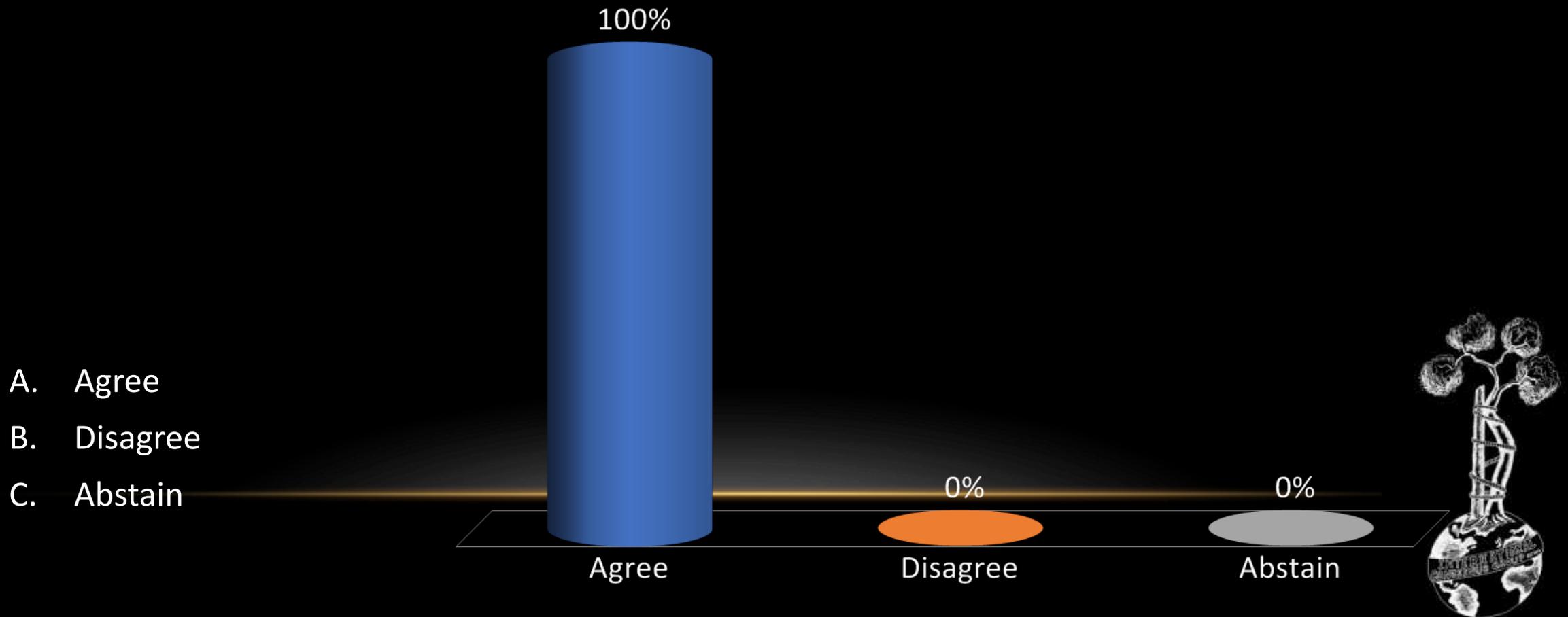
Literature:

- Evidence is limited in regards to the definition of SSI in spinal surgery
- Lacking level I or II studies



Recommendation: We recommend utilizing the definition provided by the Centers for Disease Control (CDC), National Healthcare Safety Network (NHSN) Patient Safety Component Manual, Chapter 9: Surgical Site Infection Event.

Level of Evidence: Consensus



Spin-23 (Former Spin-47) What defines delay in the diagnosis of a spine infection?

RESEARCHED BY:



Claus Simpfendorfer



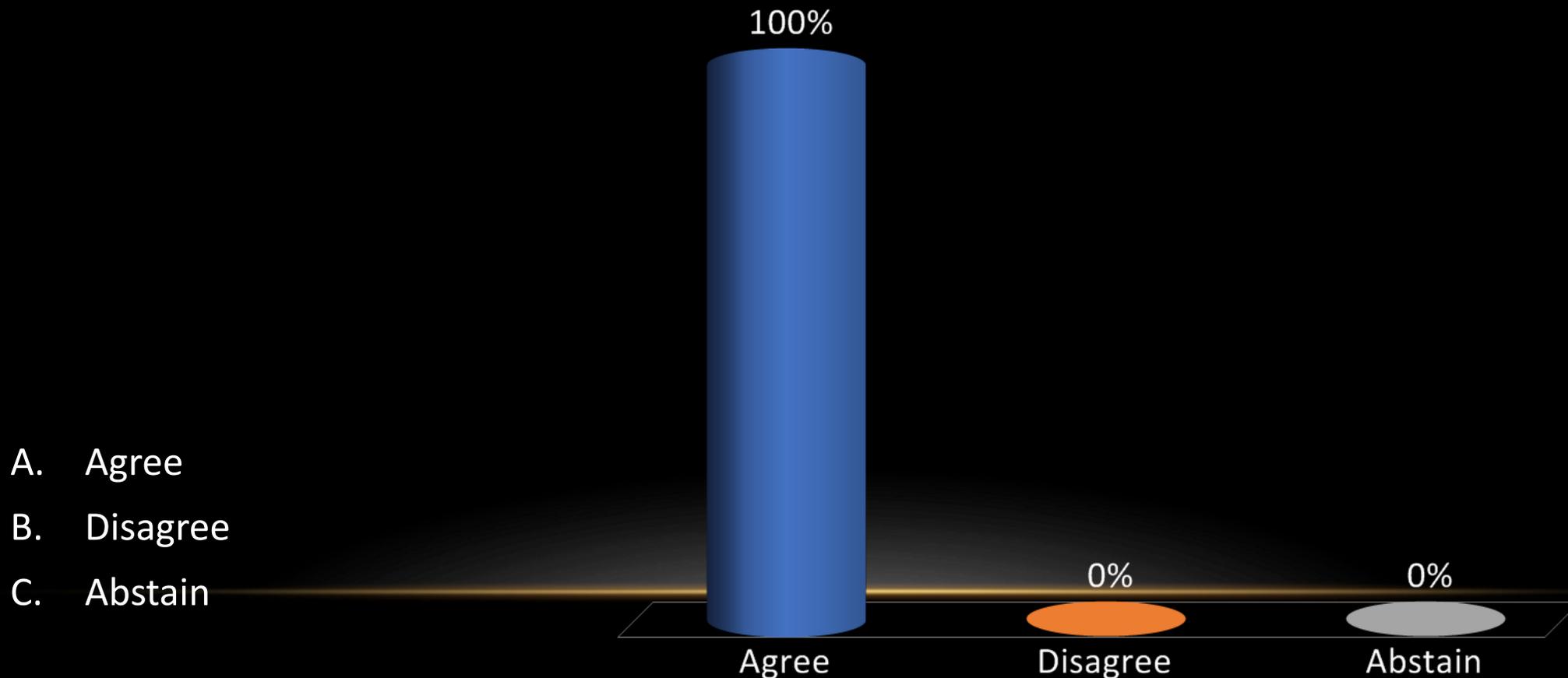
Literature:

- **Meta-analysis 0, Prospective/randomized 0, Retrospective 4**
- **There is very limited evidence amongst the literature in regards to the definition of delay in spinal infection diagnosis. Further studies are required to validate proposed definitions**



Recommendation: There is no clear or established definition of delayed diagnosis for spine infection.

Level of Evidence: Limited



- A. Agree
- B. Disagree
- C. Abstain



Spin-24 (Former Spin-1) Are there any diagnostic tools that are useful for early SSI detection following spinal surgery? Does this differ if there was instrumentation or not?

RESEARCHED BY:



Maja Babic



Literature:

- **Meta-analysis 0, Prospective/randomized 2, Retrospective 0**
- **Two prospective studies provide moderate evidence supporting the use of CRP for early SSI detection**

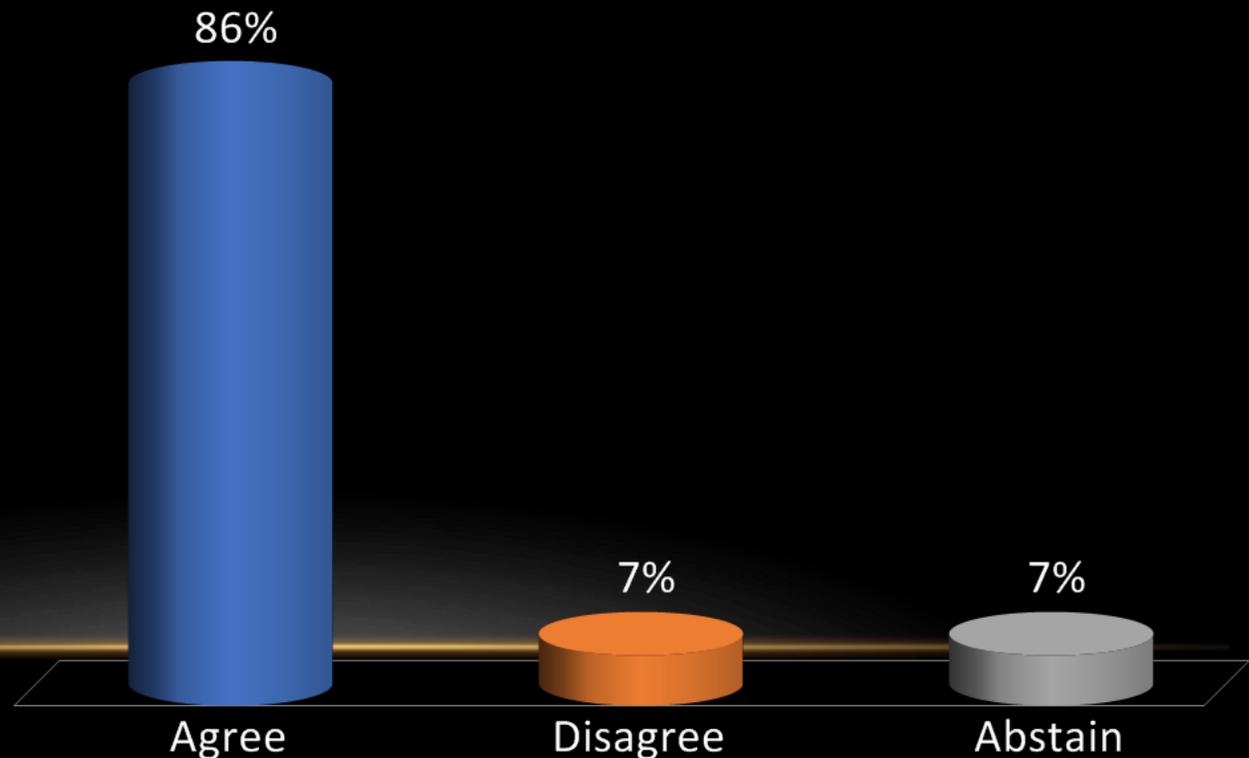


Recommendation: CRP can be a useful adjunctive diagnostic tool for early SSI following spinal surgery.

A failure of CRP to decline or a second rise on postoperative days 4-7 is a sensitive yet non-specific marker for infection following spine surgery, including both instrumented and non-instrumented spine surgery.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Spin-25 (Former Spin-62) When do common blood biomarkers (e.g. CRP, ESR, procalcitonin) normalize after spine surgery?

RESEARCHED BY:



Maja Babic



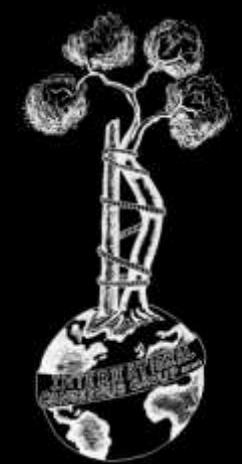
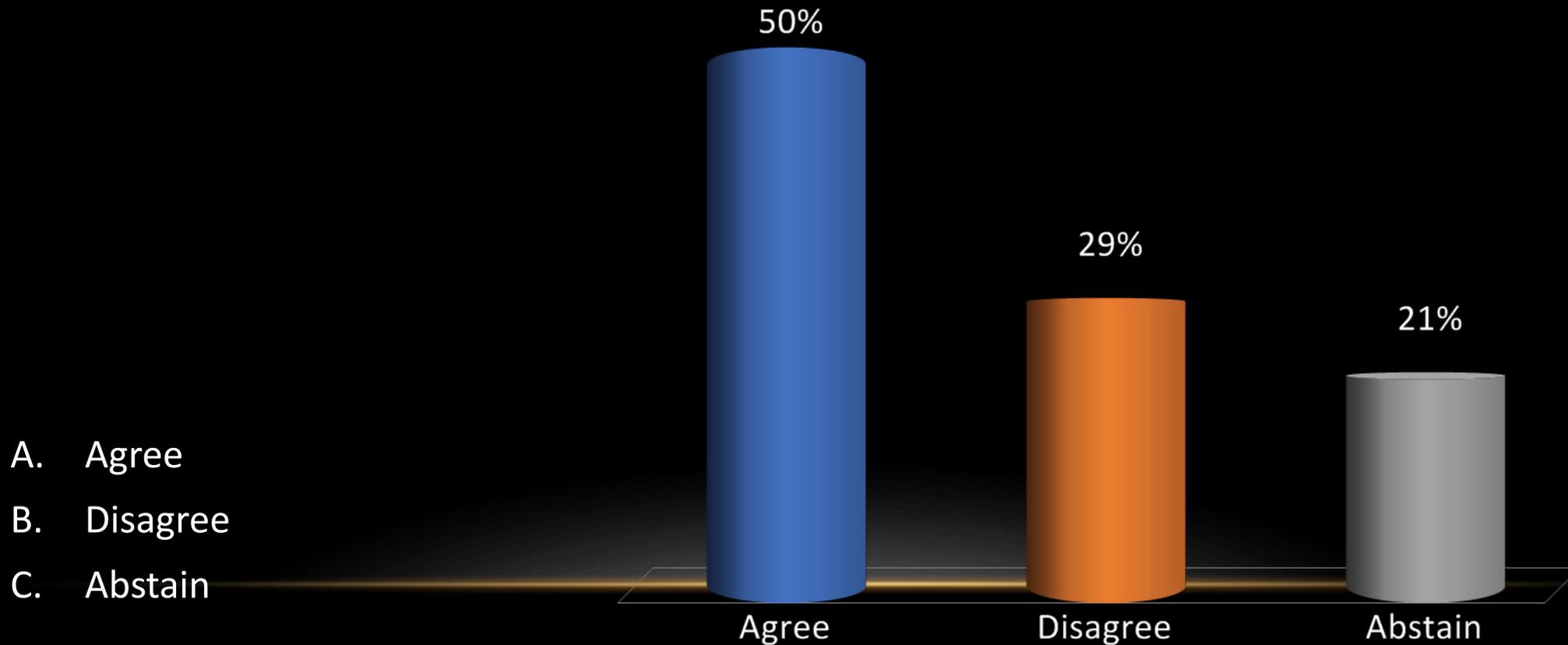
Literature:

- **Meta-analysis 0, Prospective/randomized 4, Retrospective 0**
- **Multiple prospective studies provide moderate level evidence supporting the normalization timeframes of these blood biomarkers**



Recommendation: Following spinal surgery with or without instrumentation- CRP values peak on days 2-3 postoperatively and normalize within 14 days. ESR normalizes within 14 days.

Level of Evidence: Moderate



Spin-26 (Former Spin-31) Is there a role for the use of serum biomarker for diagnosis of spinal surgical site infection?

RESEARCHED BY:



Maja Babic



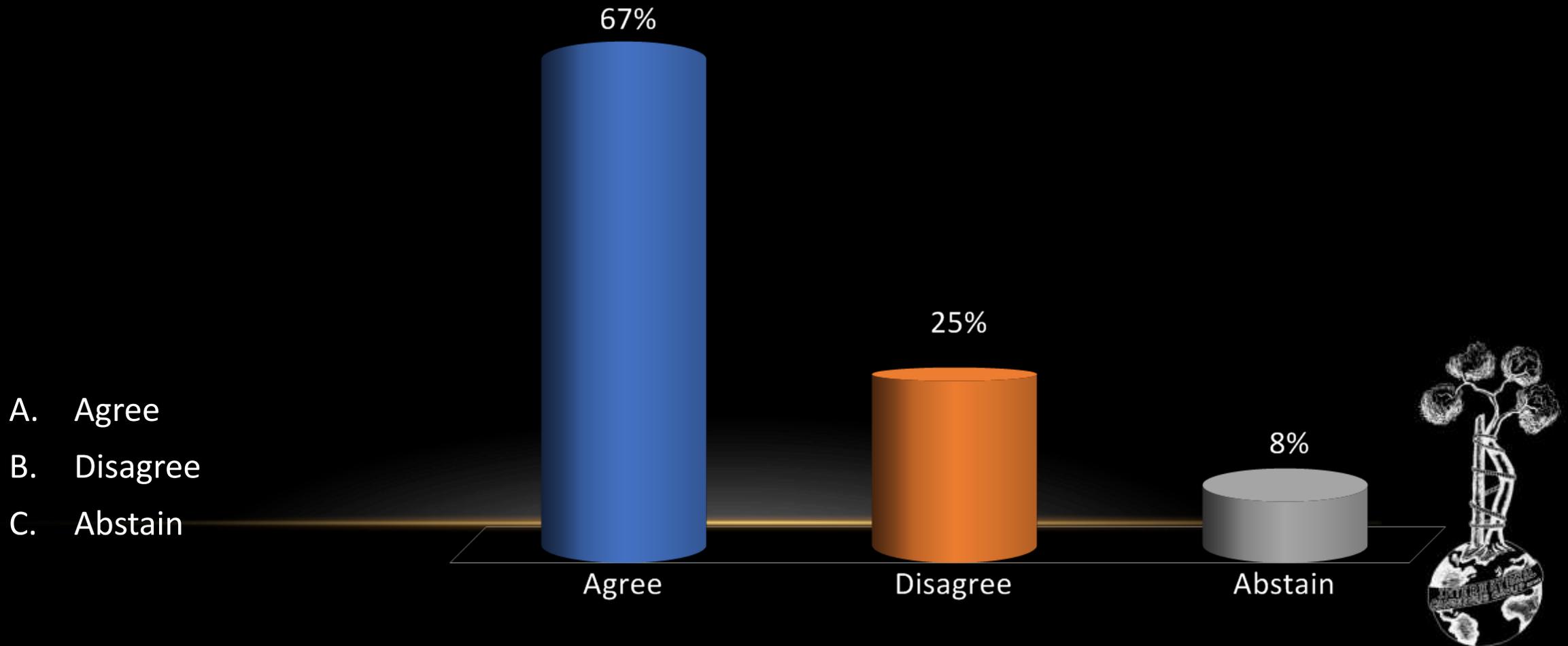
Literature:

- **Meta-analysis 0, Prospective/randomized 3, Retrospective 0**
- **Multiple prospective studies support the use of CRP's use as a serum biomarker of spinal SSI**



Recommendation: Yes, CRP is a predictable marker for early infectious complications following spine surgery. ESR and WBC have nonspecific kinetics that are less helpful in identifying early SSI.

Level of Evidence: Moderate



Spin-27 (Former Spin-54) What is the optimal imaging in diagnosis of spine infections? If MRI is contraindicated, what imaging modality should be used?

RESEARCHED BY:



Craig Chad



Literature:

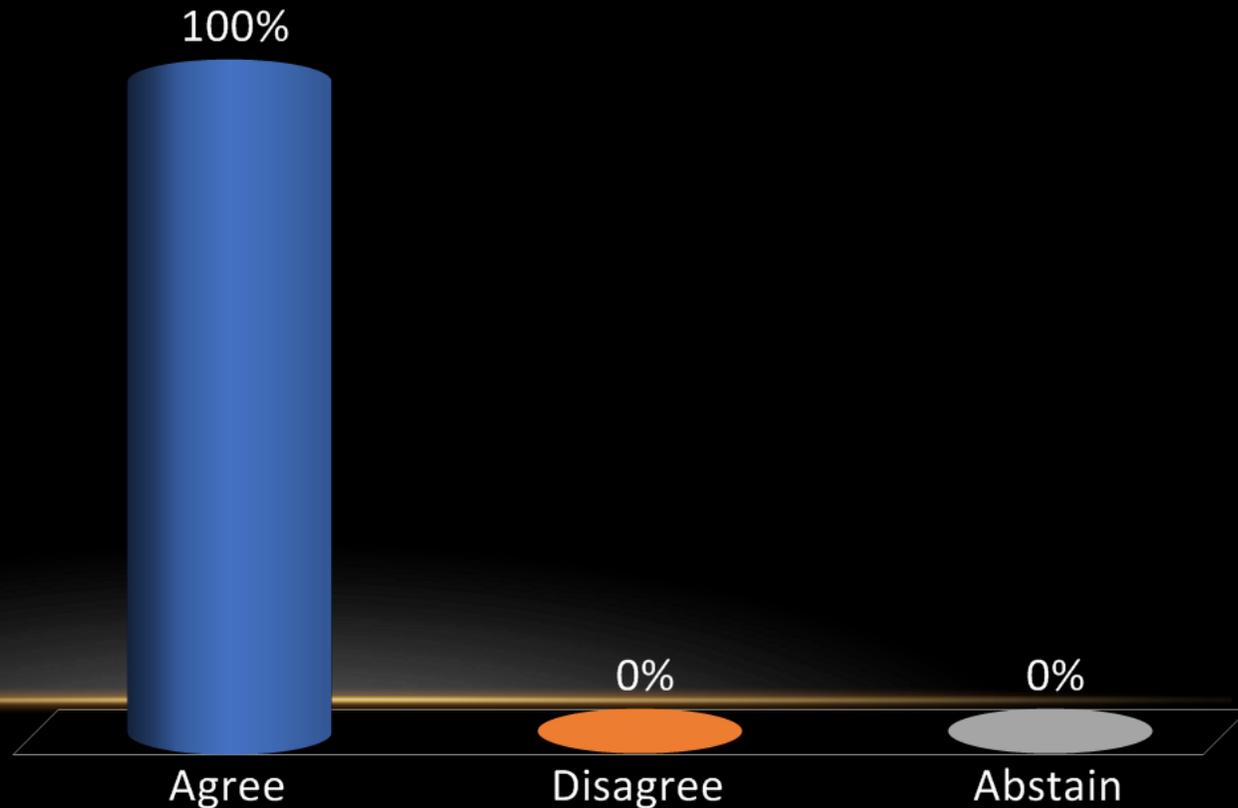
- **Meta-analysis 0, Prospective/randomized 0, Retrospective 4**
- **No current studies have been able to show non-superiority of other imaging techniques to MRI. There is moderate evidence consisting of case-reports and retrospective studies supporting other modalities in light of MRI contraindications**



Recommendation: MRI remains the gold standard for the diagnosis of spinal infection, with sensitivity and specificity above 90%. In the presence of MRI contraindications, consider a combination of modalities, such as CT, PET-CT, and SPECT+ 67 Gallium or 67 Gallium and Technetium-99.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Spin-28 (Former Spin-22) Is there a role for CT scan with contrast in the diagnosis of spinal infections in patients who cannot undergo MRI?

RESEARCHED BY:



John Koerner



Christopher Kepler



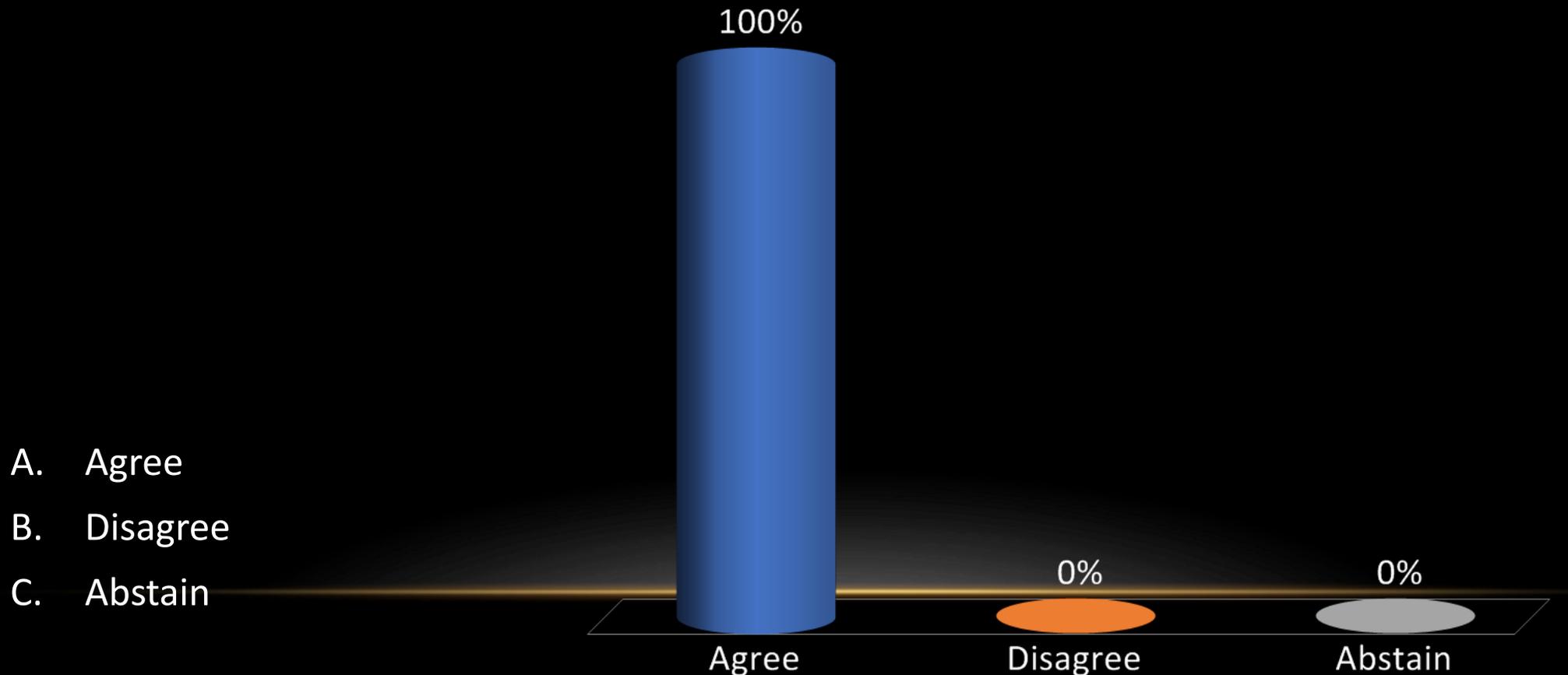
Literature:

- **Current literature has not studied the role of CT scan with contrast in patients with contraindications to MRI**



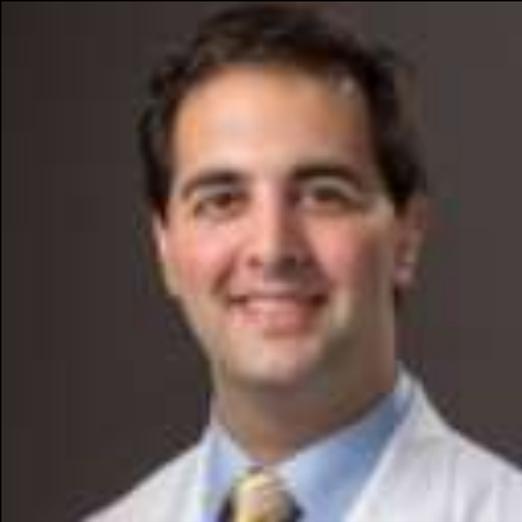
Recommendation: Although evidence is limited for the routine use of CT scan with contrast, there is a role for it to be used in the presence of spine infection where MRI is contraindicated or other advanced imaging is not available

Level of Evidence: Consensus



Spin-29 (Former Spin-24) Is there a role for nuclear imaging (e.g. PET scan) in the diagnosis of spinal infections?

RESEARCHED BY:



Glenn Russo



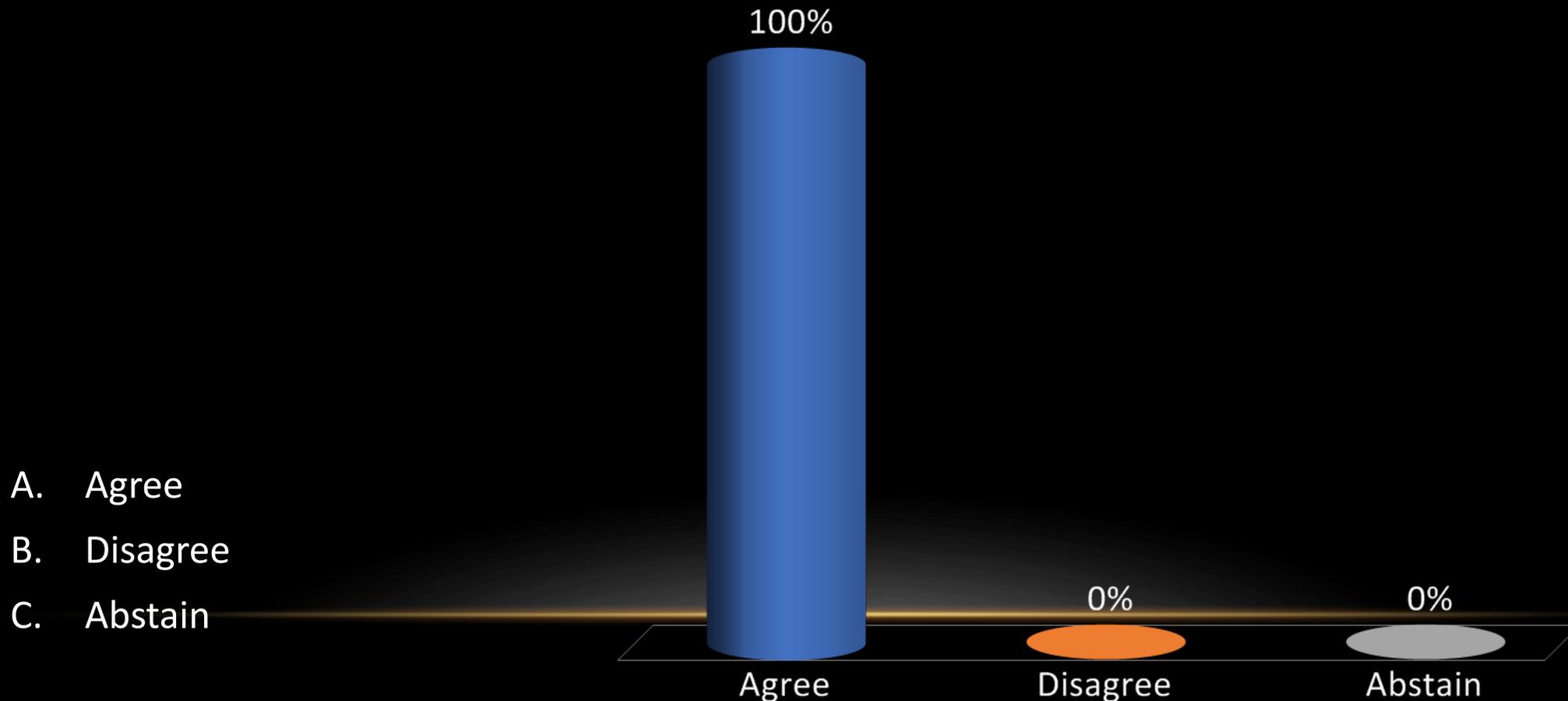
Literature:

- **Meta-analysis 0, Prospective/randomized 6, Retrospective 0**
- **Moderate level evidence supports nuclear imaging as an adjunct to MRI in the diagnosis of spinal infections**



Recommendation: PET scan, preferably PET CT, can be used as an adjunct to MRI to diagnose spinal infections when an MRI cannot be performed or is inconclusive.

Level of Evidence: Moderate



- A. Agree
- B. Disagree
- C. Abstain



Spin-30 (Former Spin-7) How can postoperative infections be distinguished from normal postoperative changes on MRI?

RESEARCHED BY:

Susana Nunez-Pereira MD,
Spain

Anand Segar MD,



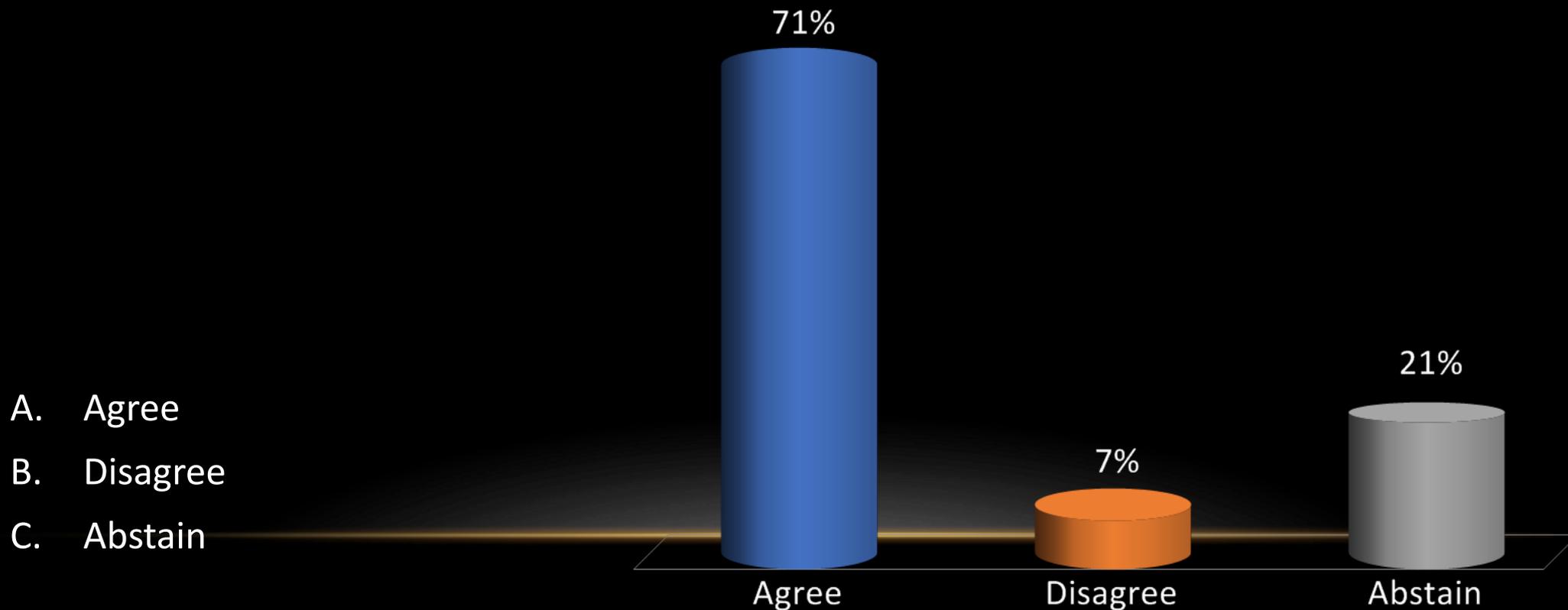
Literature:

- **Meta-analysis 0, Prospective/randomized 0, Retrospective 3**
- **Current literature is limited in regard to distinguishing post-op infection from normal post-op changes on MRI**



Recommendation: The presence of abscess in the back muscles or posterior site, confirmed by gadolinium enhancement, is the most frequently reported change on MRI of patients with SSI. The presence of a collection of fluid outside the head of the pedicle screws is another sign of SSI.

Level of Evidence: Limited



Spin-31 (Former Spin-23) Is there a role for molecular techniques such as polymerase chain reaction (PCR) or next generation sequencing (NGS) for diagnosis of spinal surgery infection? If so, in which group of patients should this be done?

RESEARCHED BY:

Bryan Alexander



Literature:

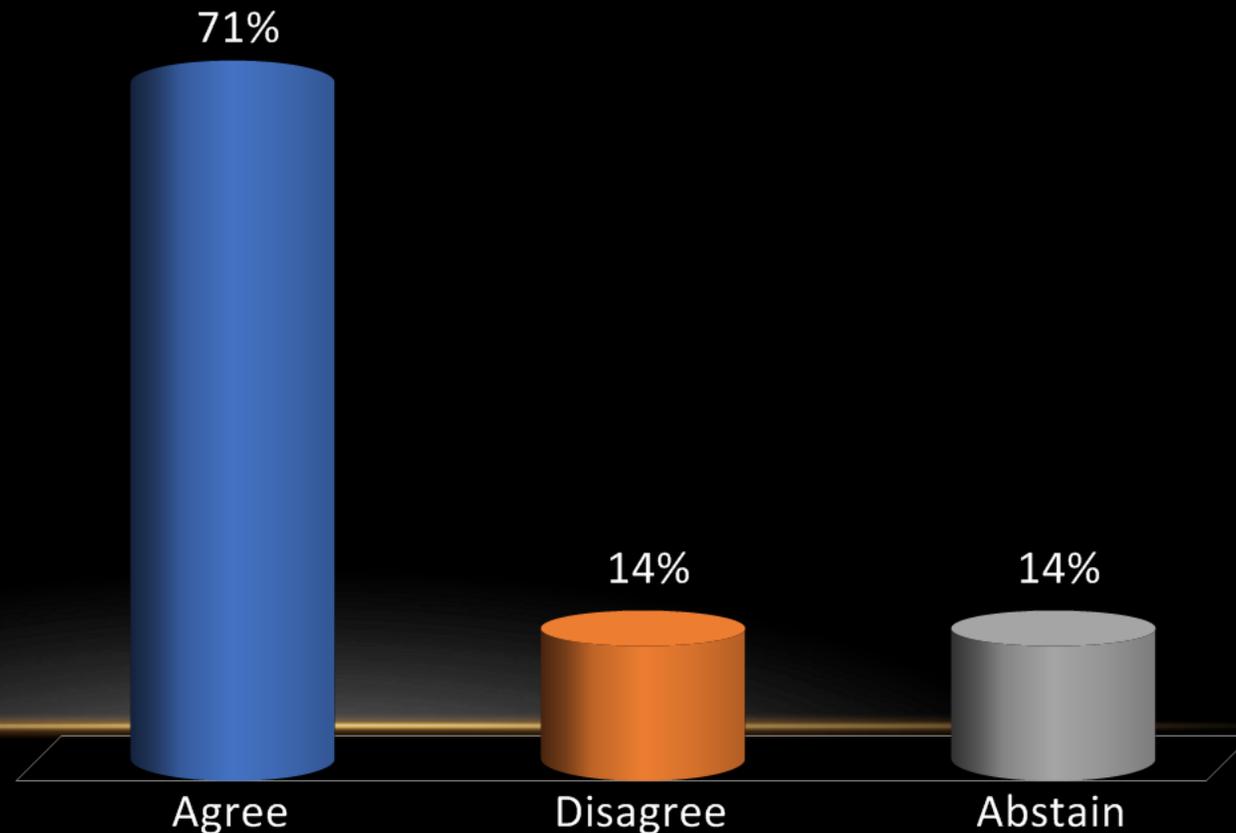
- **Meta-analysis 0, Prospective/randomized 2, Retrospective 0**
- **There is limited data on NGS/PCR in the spinal literature. The limited data currently available lies literature from other orthopedic concentrations**



Recommendation: It is reasonable to selectively incorporate these diagnostic modalities as an adjunct to standard methodologies where there is a history or high pre-test probability for culture negative infection.

Level of Evidence: Consensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-32 (Former Spin-2) Are there patients with degenerative pathology, such as disc herniations, who are actually infected with a low-grade infection (e.g. *Propionibacterium acnes*)?

RESEARCHED BY:

Bryan Alexander



Literature:

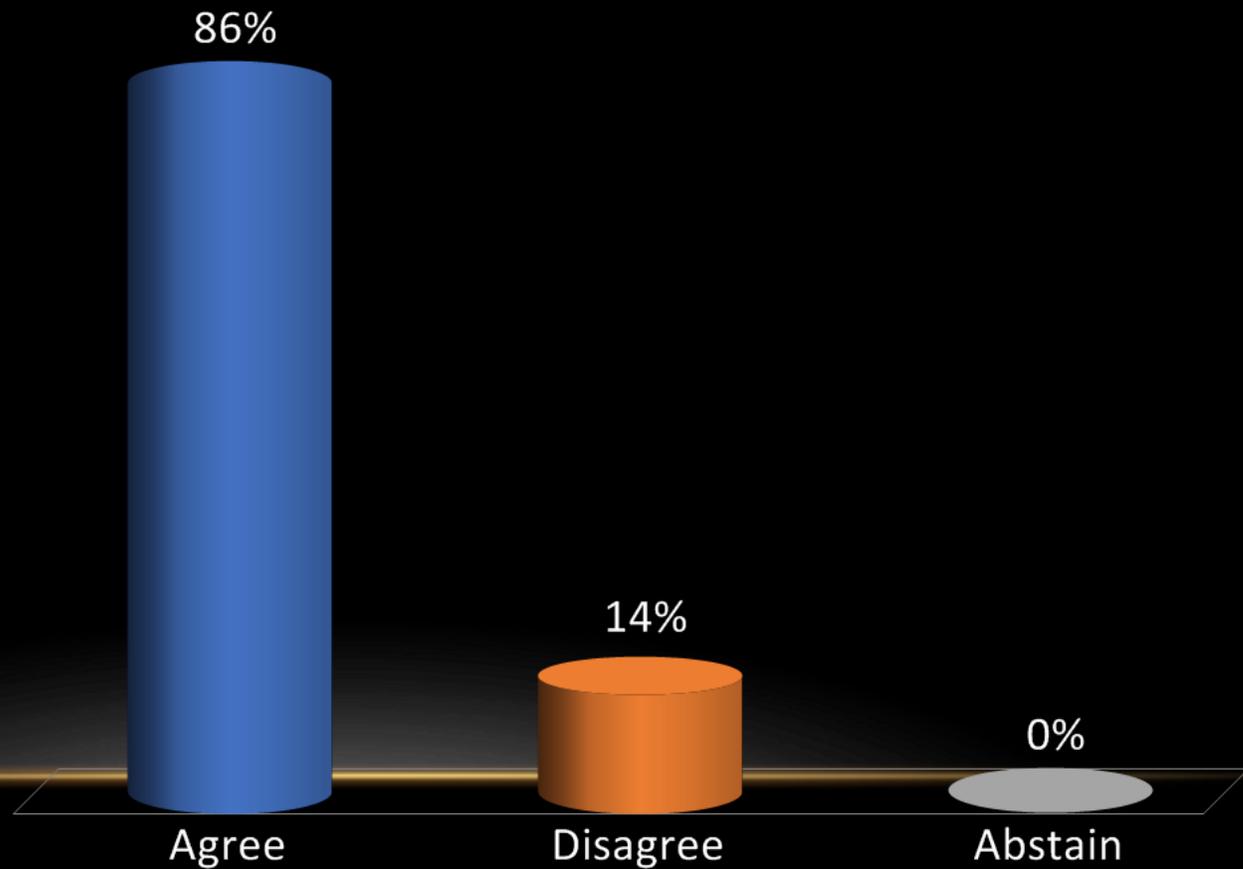
- **Meta-analysis 2, Prospective/randomized 1, Retrospective 0**
- **High-level studies have provided some evidence for the role of infection in degenerative spine pathologies. More randomized controlled studies are needed to further support this evidence base.**



Recommendation: The association between the C. acnes (former P. acnes) with degenerative spinal disease is inconclusive.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-33 (Former Spin-36) Should antibiotics be held prior to image guided biopsy/aspiration for a suspected spine infection?

RESEARCHED BY:



Taolin Fang



Literature:

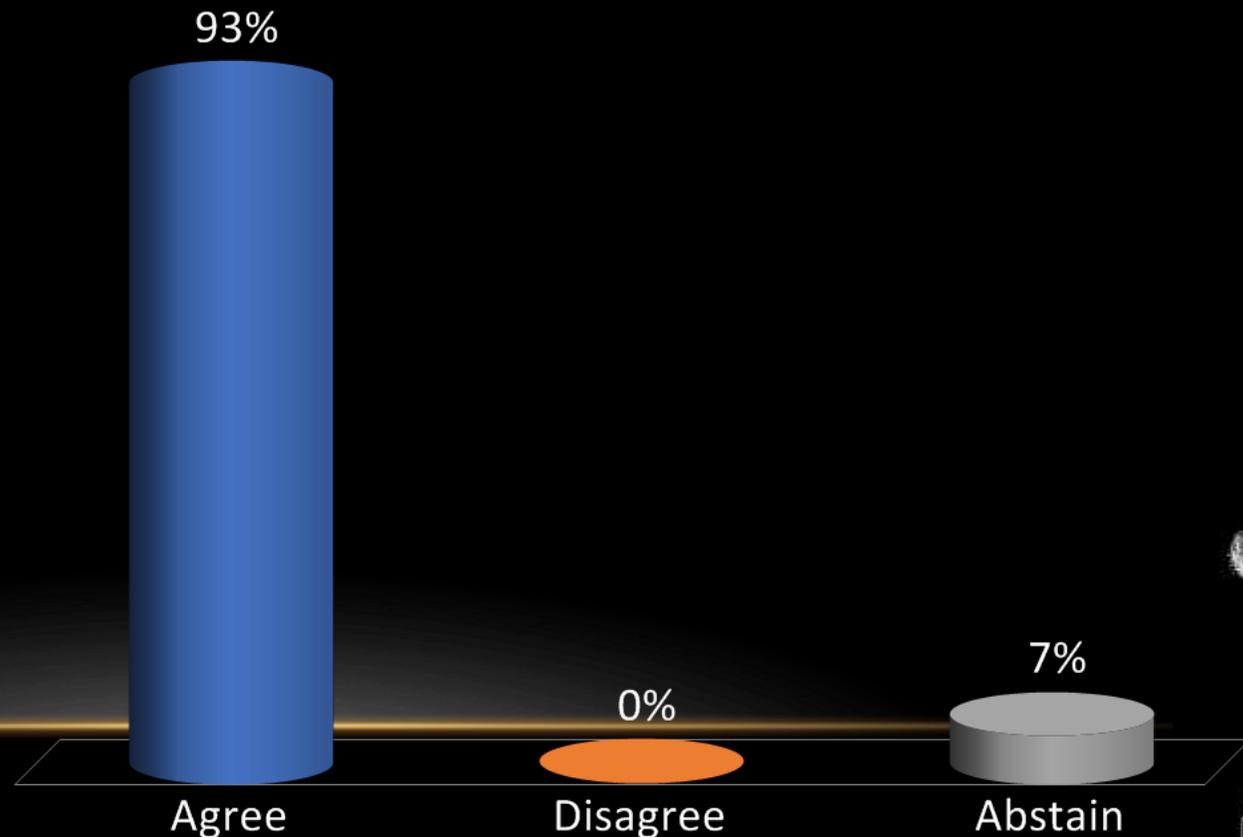
- **Meta-analysis 0, Prospective/randomized 0, Retrospective 6**
- **Limited evidence can be found in the spinal literature regarding the holding of antibiotics prior to biopsy/aspiration. What evidence is present comes from other fields.**



Recommendation: We recommend that prior to image guided biopsy/aspiration for a suspected spine infection, all antibiotics be withheld until after appropriate culture samples are obtained. Antibiotic administration, without aspiration/biopsy may be justified in patients who are critically ill and cannot withstand intervention or in patients with deteriorating neurological conditions.

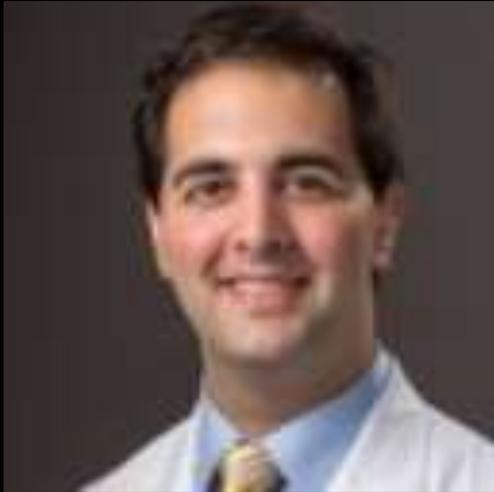
Level of Evidence: Consensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-34 (Former Spin-48) What investigations should samples obtained by image-guided biopsy be sent for?

RESEARCHED BY:



Glenn Russo



Literature:

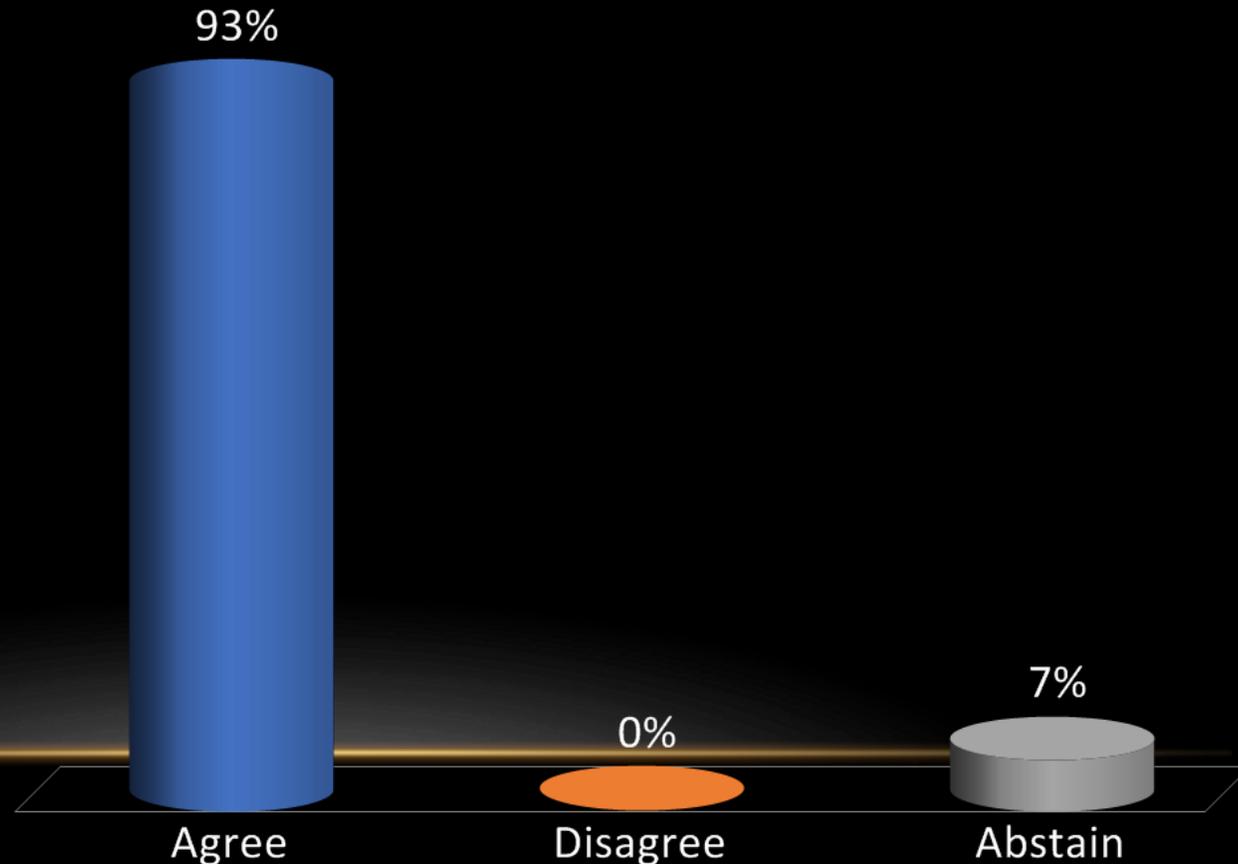
- **Meta-analysis 0, Prospective/randomized 0, Retrospective 1**
- **Limited data is available and currently is based off society guidelines and case reports**



Recommendation: A priority should be placed on obtaining bacterial cultures and pathohistology. In the appropriate epidemiological setting, mycobacterial, fungal, and brucellar cultures can be considered.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-35 (Former Spin-50) What is the diagnostic algorithm of patients with suspected hematogenous vertebral osteomyelitis? Is the algorithm different for patients with tuberculosis?

RESEARCHED BY:

Barrett Woods MD,
USA

Maja Babic MD, USA



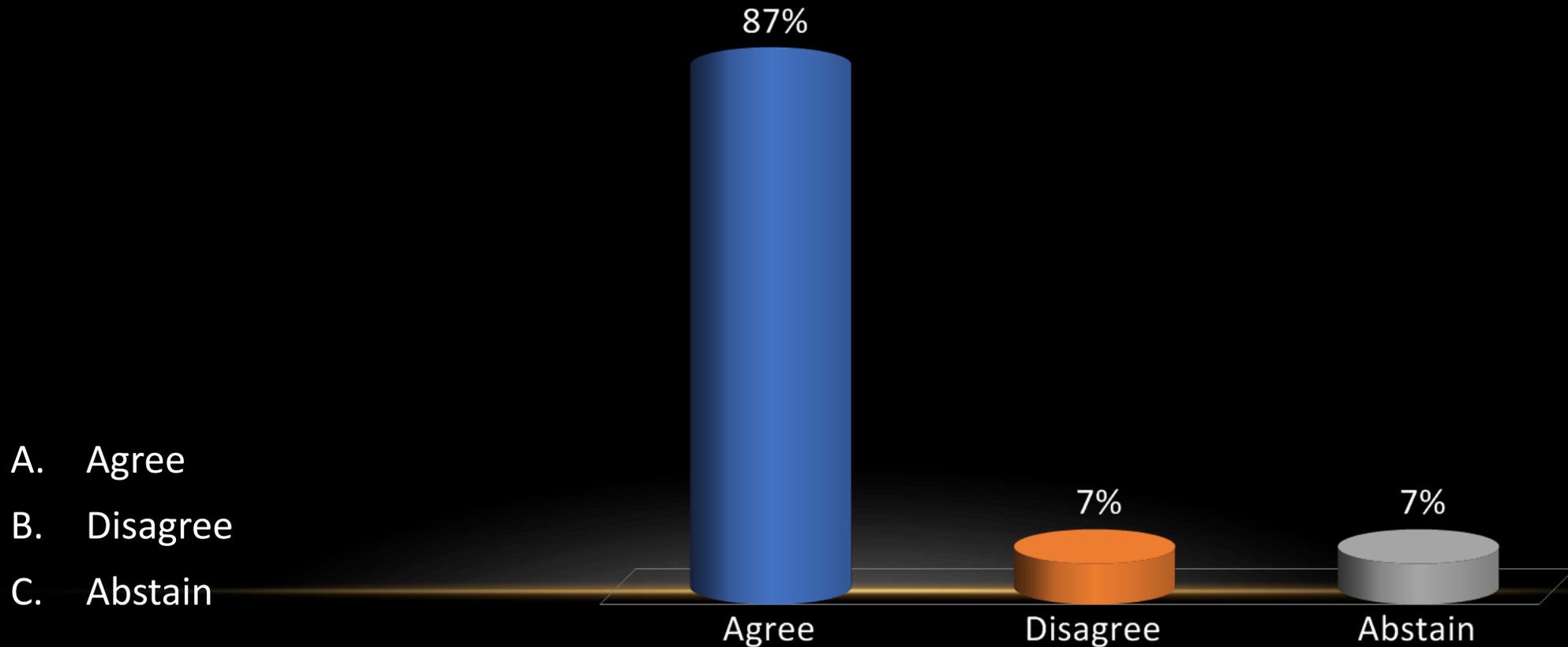
Literature:

- **Meta-analysis 2, Prospective/randomized 0, Retrospective 3**
- **2 meta-analyses support a defined algorithm for suspected hematogenous vertebral osteomyelitis, however more studies need to be conducted for further validation.**



Recommendation: We support the diagnostic algorithm for suspected hematogenous vertebral osteomyelitis per IDSA guideline 2015.

Level of Evidence: Moderate



- A. Agree
- B. Disagree
- C. Abstain



Spin-36 (Former Spin-51) What is the incidence of infectious meningitis following spinal surgery? Does the use of instrumentation affect this?

RESEARCHED BY:



Koji Yamada

Alexander Montgomery



Literature:

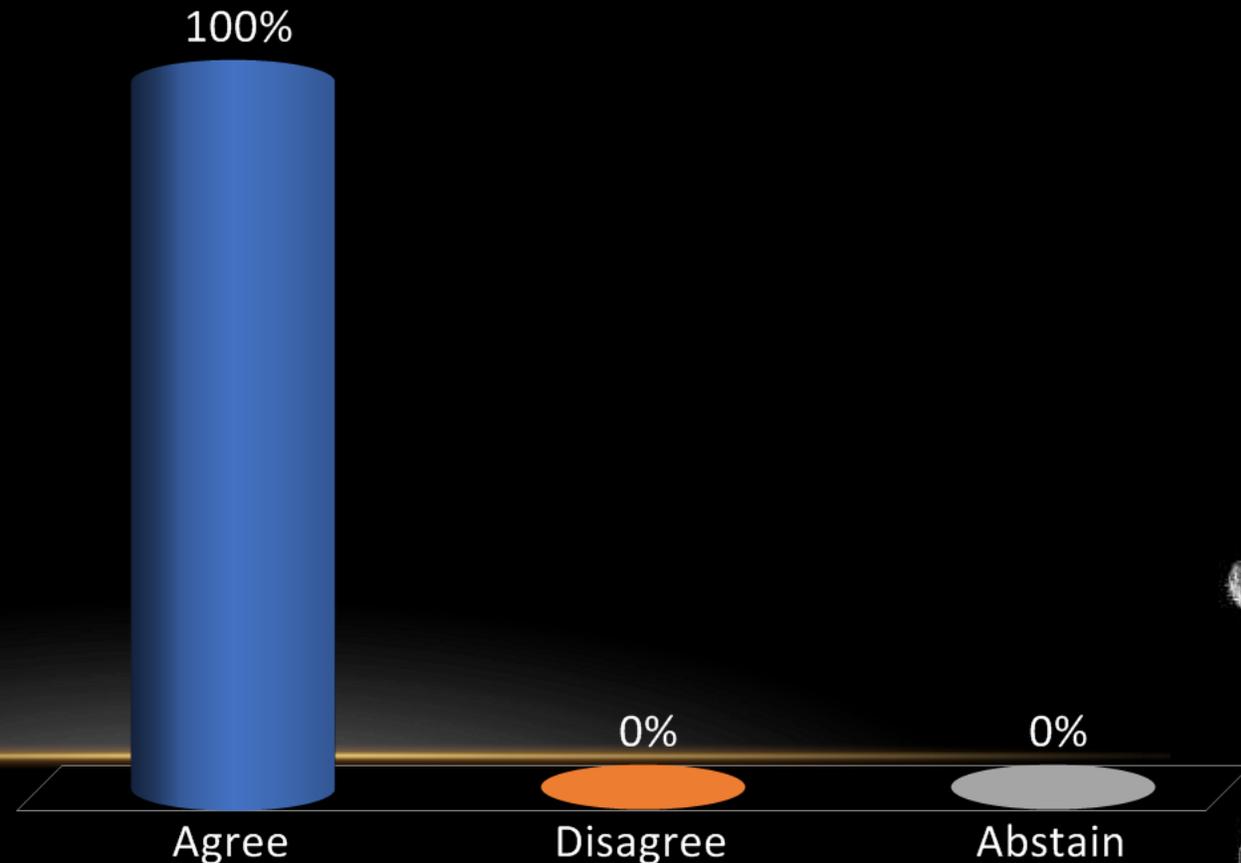
- **Meta-analysis 1, Prospective/randomized 0, Retrospective 3**
- **Several retrospective studies report the incidence of infectious meningitis but there is a lack of evidence for the effect of instrumentation on this condition.**



Recommendation: The incidence of postoperative infectious bacterial meningitis (PBM) following spinal surgery varies from 0.1-0.4%. There is insufficient evidence to make any observations as to whether the use of instrumentation affects the incidence of infectious meningitis following spinal surgery.

Level of Evidence: Consensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-37 (Former Spin-11) How many intraoperative tissue samples should be sent for culture in suspected spinal surgery infection?

RESEARCHED BY:



Chad Craig



Literature:

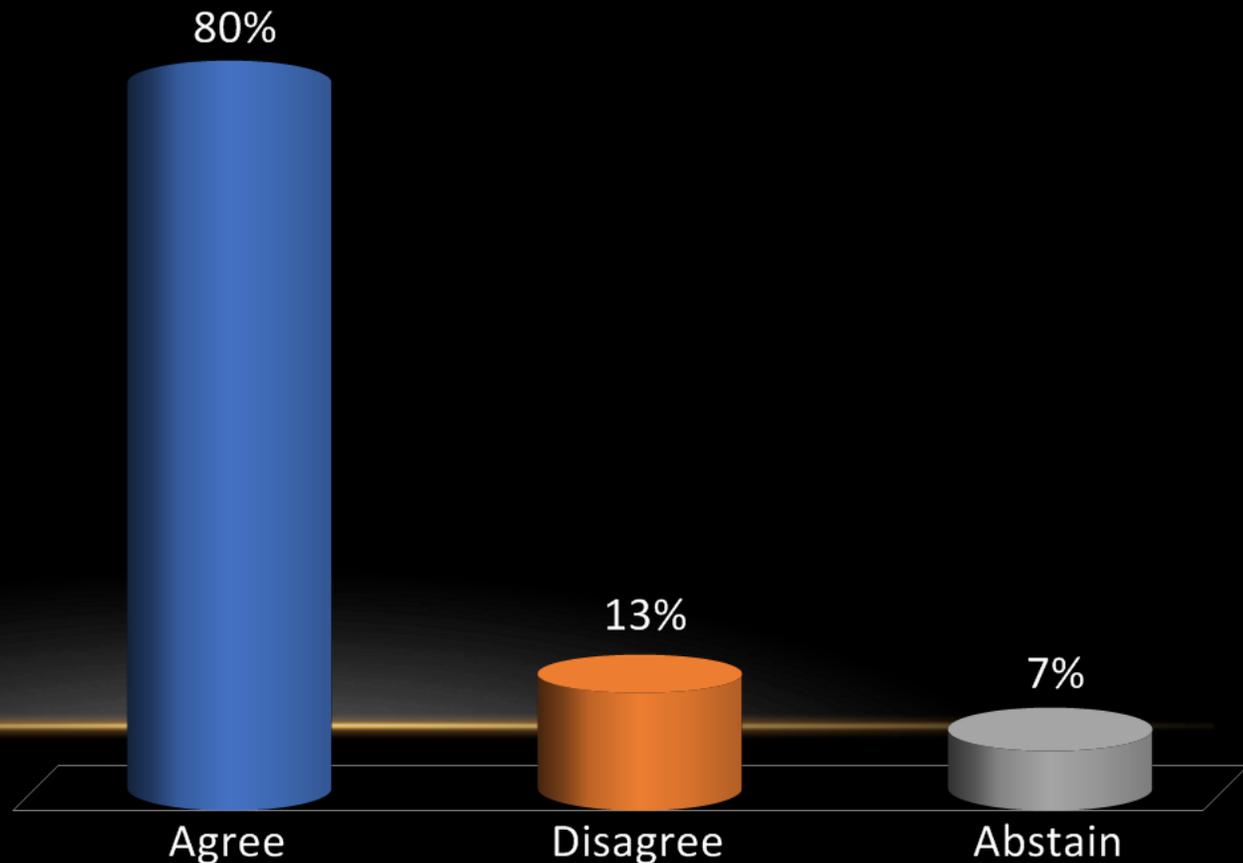
- **Meta-analysis 0, Prospective/randomized 0, Retrospective 3**
- **Little evidence is available in the spinal literature addressing an optimal number of samples. Further study is needed to better elucidate diagnostic standard.**



Recommendation: With the currently available evidence, it is recommended that at least three to five tissue samples be sent for culture in cases of suspected spinal infection. In the setting of instrumentation, we recommend additional techniques, such as vortexing and sonification, to increase the yield of culture samples.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-38 (Former Spin-33) Is there an optimal window for diagnosis of an early spine infection to retain instrumentation?

RESEARCHED BY:

John Koerner, USA

David Kaye, USA



Literature:

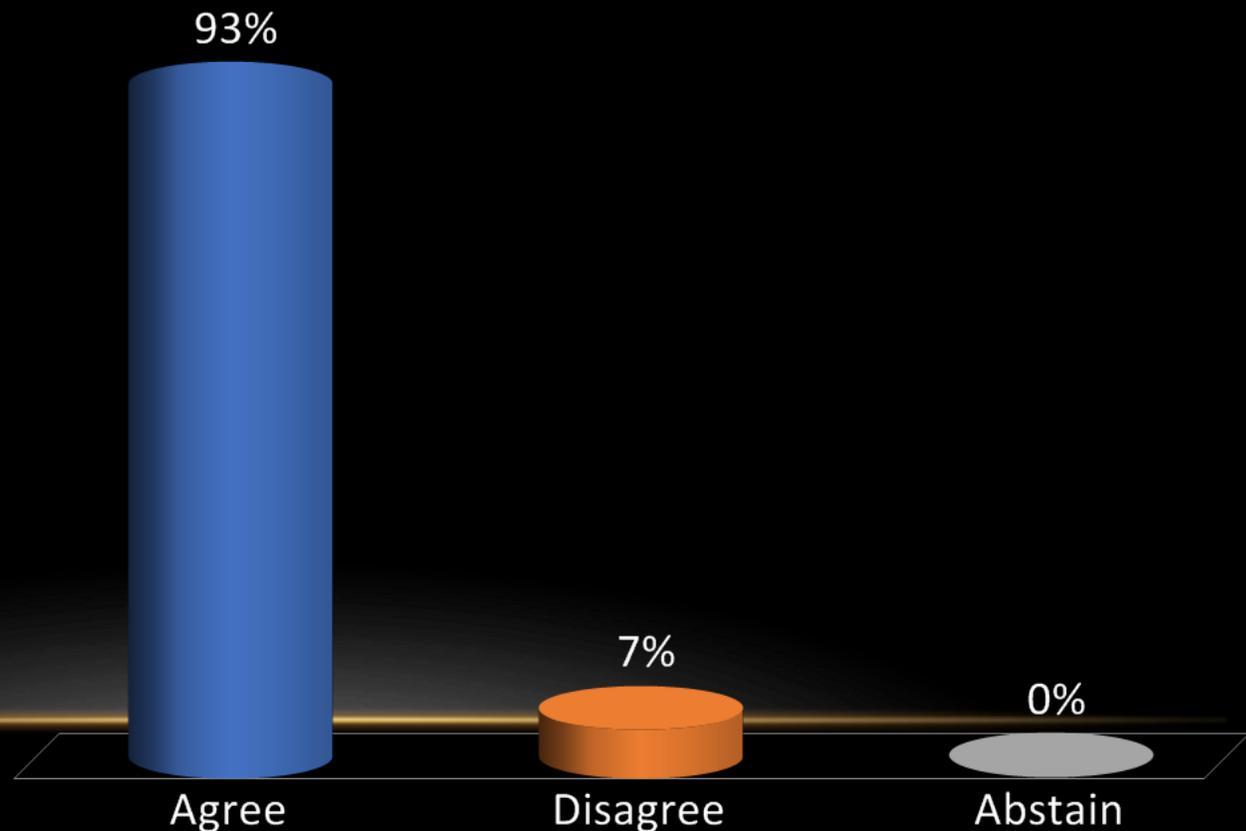
- **Meta-analysis 0, Prospective/randomized 0, Retrospective 5**
- **Evidence is limited and of low quality currently and more studies need to be conducted.**



Recommendation: There is no defined window, but early diagnosis of a postoperative spine infection (up to 3 months from time of surgery) treated with surgical debridement and antibiotics often allows for retention of instrumentation.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-39 (Former Spin-43) What are the early infectious complications after operations on the spine following the use of instrumentation?

RESEARCHED BY:



Taolin Fang



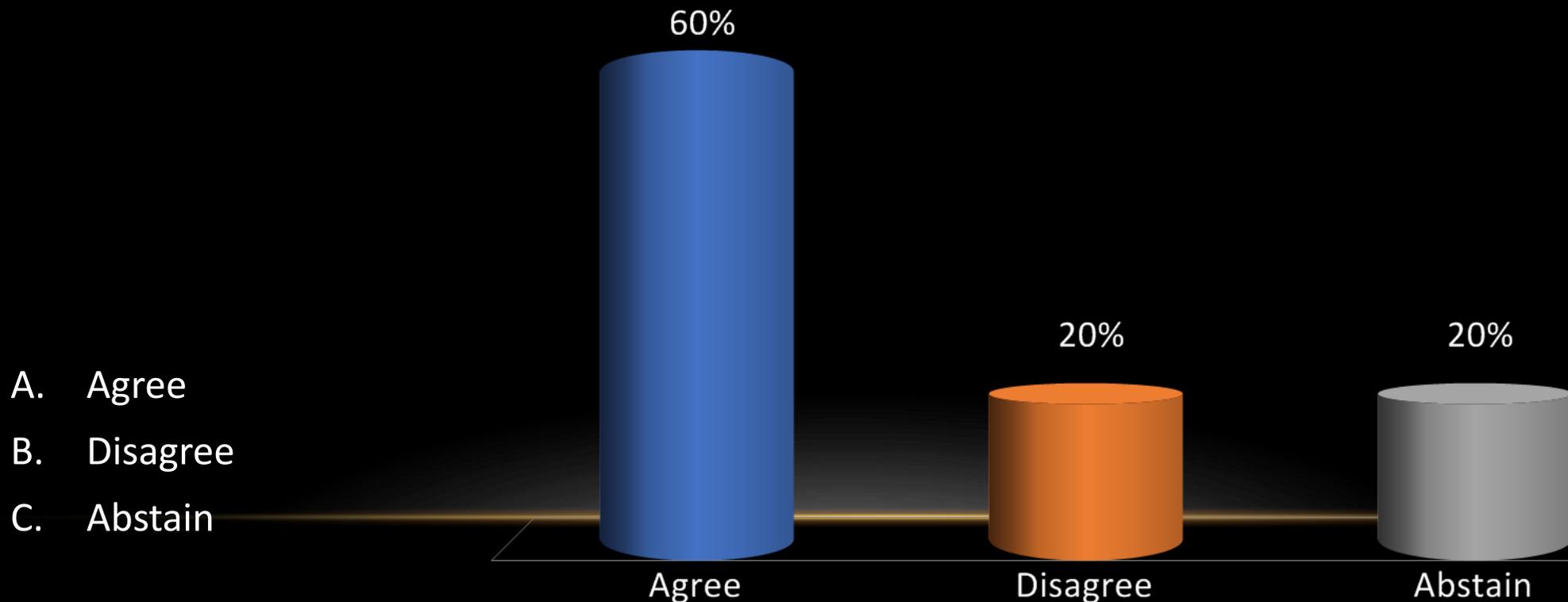
Literature:

- **Meta-analysis 0, Prospective/randomized 0, Retrospective 6**
- **Limited evidence currently therefore it has not been properly elucidated whether MIS spine surgery with instrumentation has lower infection rates vs. open surgery**



Recommendation: Early infections are traditionally defined as those occurring within a month after surgery, typically become evident within 2-3 weeks of surgery. Recently the definition has been broadened as the infection within 90 days of surgery.

Level of Evidence: Consensus



Spin-40 (Former Spin-8) How do early and late infectious complications differ following spine surgery?

RESEARCHED BY:



Gregory Schroeder



Literature:

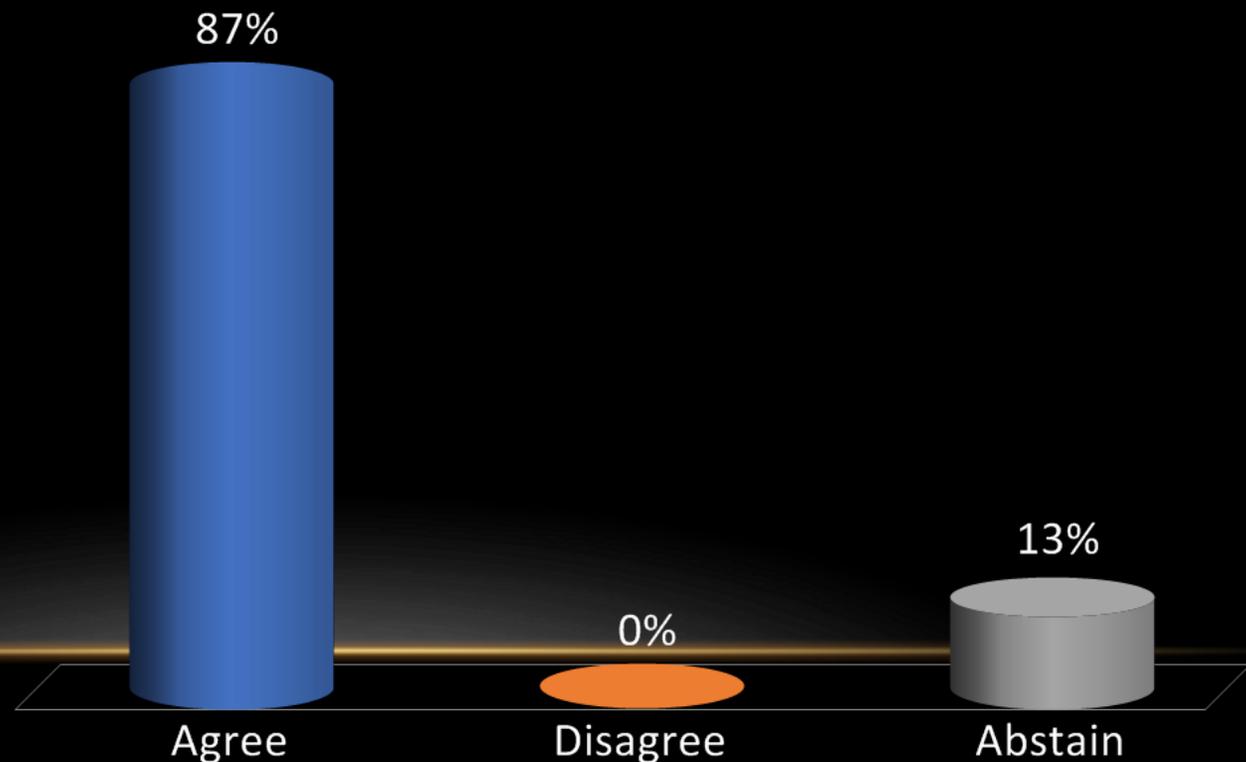
- **Meta-analysis 2, Prospective/randomized 0, Retrospective 1**
- **2 meta-analyses in addition to multiple retrospective studies provides moderate evidence to distinguish early vs. late infectious complications in spine surgery.**



Recommendation: Early infections, defined as occurring within 30 days of surgery, often present with local signs of infection, such as increased surgical site pain, erythema, warmth and wound drainage. Conversely, late infections (>90 days after surgery) commonly present with an insidious onset of chronic pain, and implant failure/pseudarthrosis if following a fusion.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Treatment



Spin-41 (Former Spin-4) Can non-surgical approach be used to treat postoperative spine infections? If so what factors predict successful outcome?

RESEARCHED BY:



Claus Simpfendorfer



Literature:

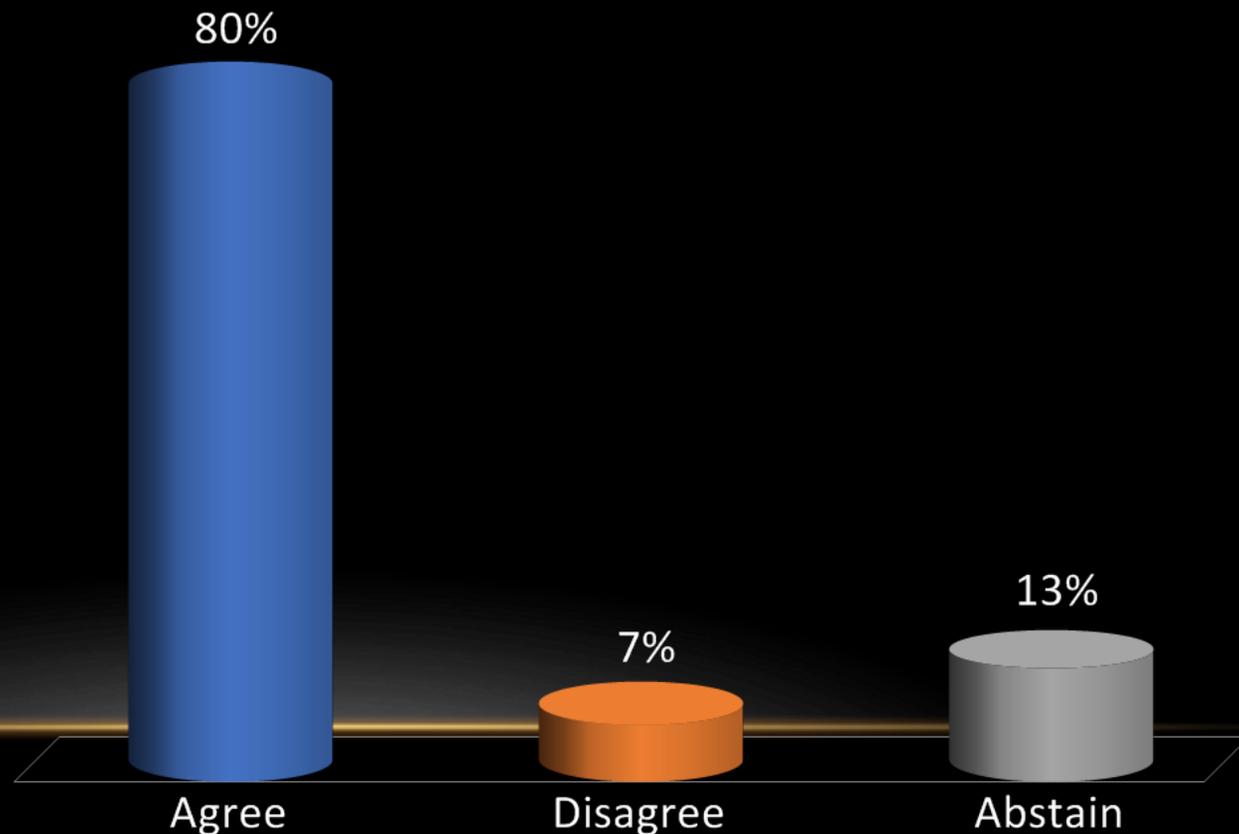
- **Meta-analysis 0, Prospective/randomized 0, Retrospective 6**
- **Multiple consistent retrospective studies are present supporting these claims.**



Recommendation: Postoperative spine infections should be treated with irrigation and debridement, with or without implant removal, followed by appropriate antibiotic therapy. Antibiotic suppression without surgical intervention is attempted in cases where the patient is not a surgical candidate, or in attempt to achieve spinal fusion prior to implant removal.

Level of Evidence: Strong

- A. Agree
- B. Disagree
- C. Abstain



Spin-42 (Former Spin-63) When should patients with suspected infections of the spine be referred to infectious disease?

RESEARCHED BY:

Susana Nunez-Pereira



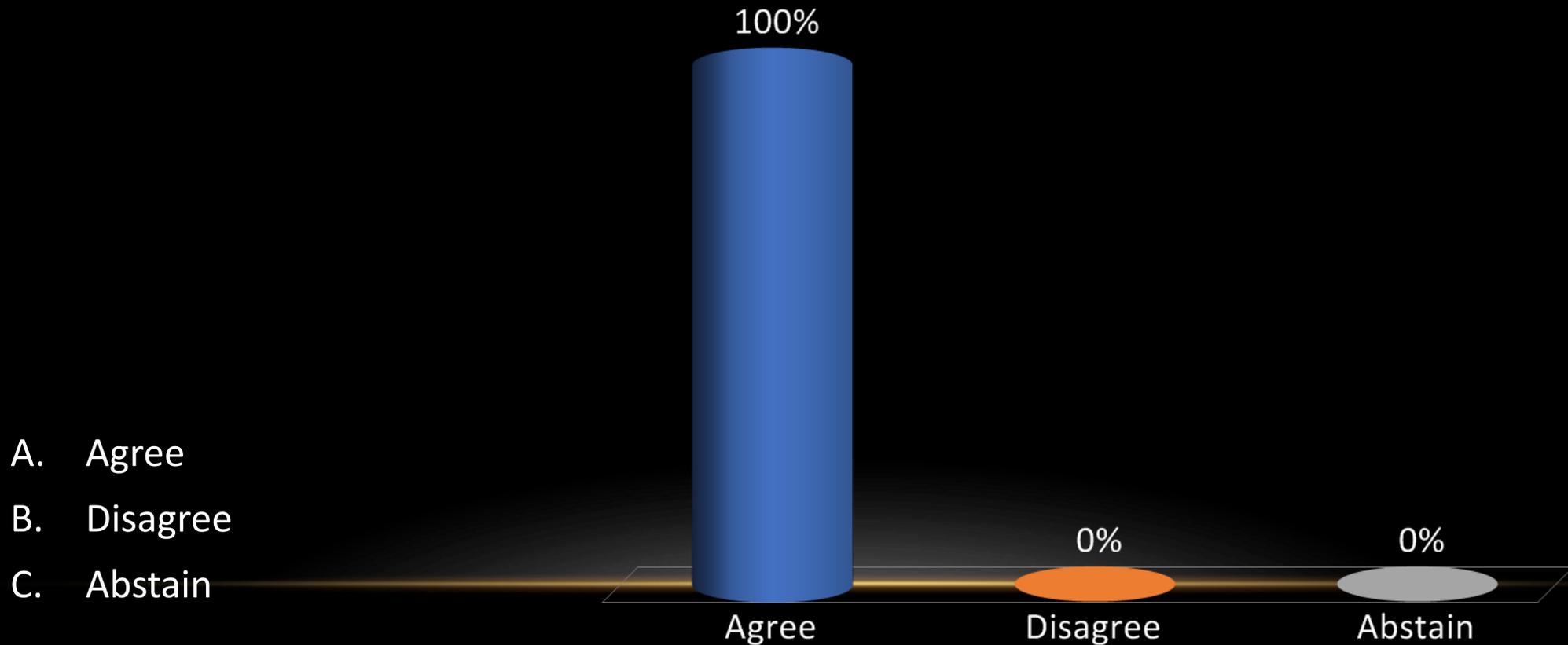
Literature:

- **Meta-analysis 0, Prospective/randomized 0, Retrospective 1**
- **Sparse data from only a single paper is present in the literature**



Recommendation: There are no data on the timing and need for a referral to infectious disease department. We support a multidisciplinary approach to manage clinical spine infection.

Level of Evidence: Consensus



- A. Agree
- B. Disagree
- C. Abstain



Spin-43 (Former Spin-27) Is there a role for oral antibiotics in the treatment of early postoperative spine infections?

RESEARCHED BY:



John Koerner



Katherine Belden



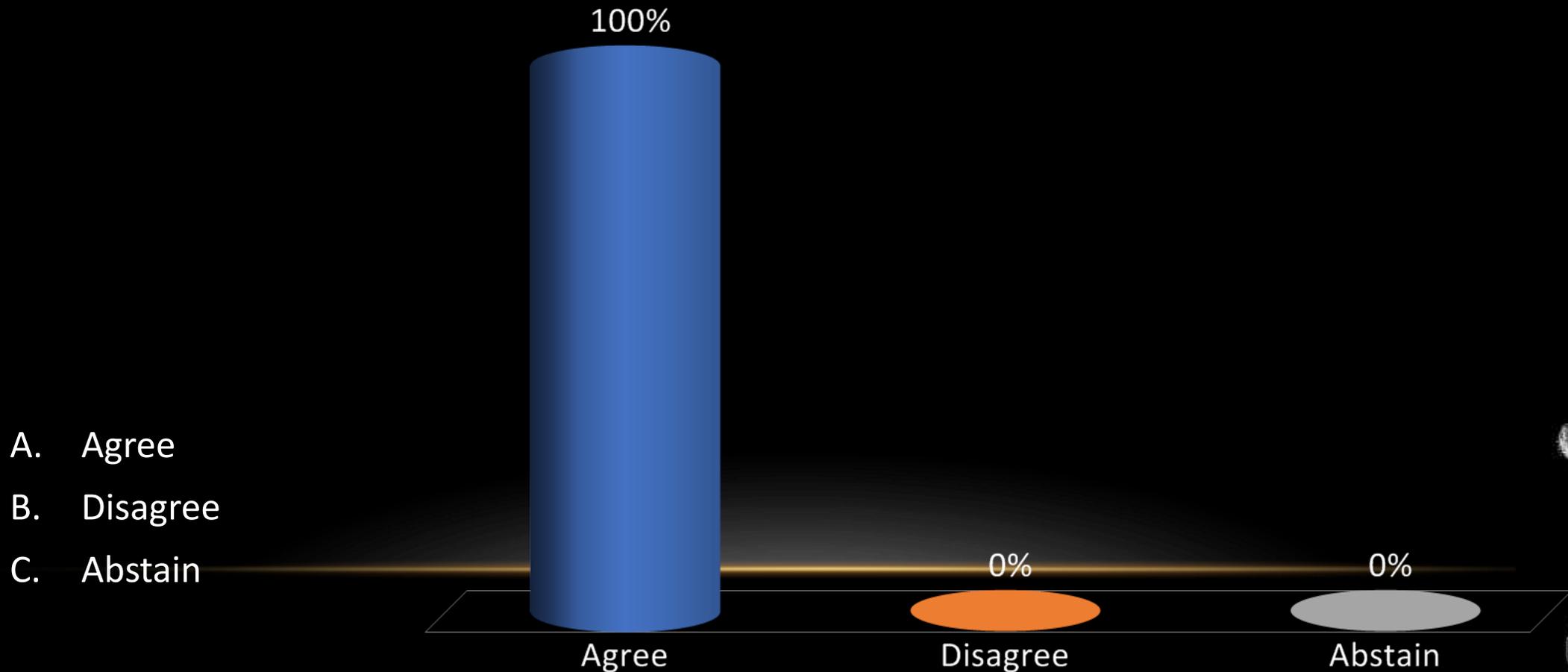
Literature:

- Evidence is mixed and controversial in regards to oral antibiotic use for early post-op spine infection. Multiple case series and retrospective studies all with varying conclusions



Recommendation: There may be a role for highly bioavailable oral antibiotics in the treatment of early postoperative spine infection in select circumstances.

Level of Evidence: Consensus



Spin-44 (Former Spin-30) Is there a role for the use of oral antibiotic in treatment of acute and chronic spinal infections?

RESEARCHED BY:



Yvonne Achermann



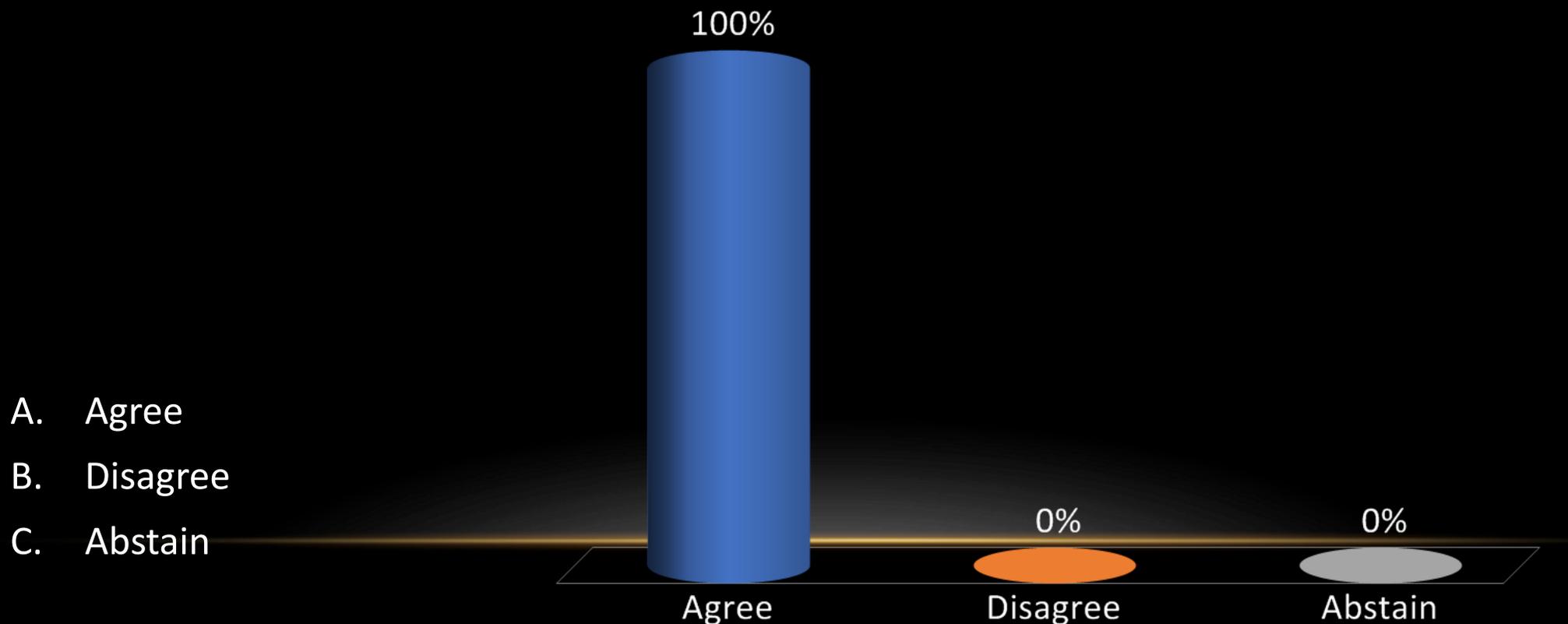
Literature:

- RCT and retrospective studies provide moderate evidence oral antibiotics following IV antibiotics in vertebral osteomyelitis.
- No consensus is present for SSI involving the deep tissue



Recommendation: There may be a role for highly bioavailable oral antibiotics in the treatment of acute and chronic spine infection in select circumstances.

Level of Evidence: moderate



Spin-45 (Former Spin-20) Is there a role for chronic antibiotic suppression after treating patients with retained infected spinal hardware?

RESEARCHED BY:

Susana Nunez-Pereira



Literature:

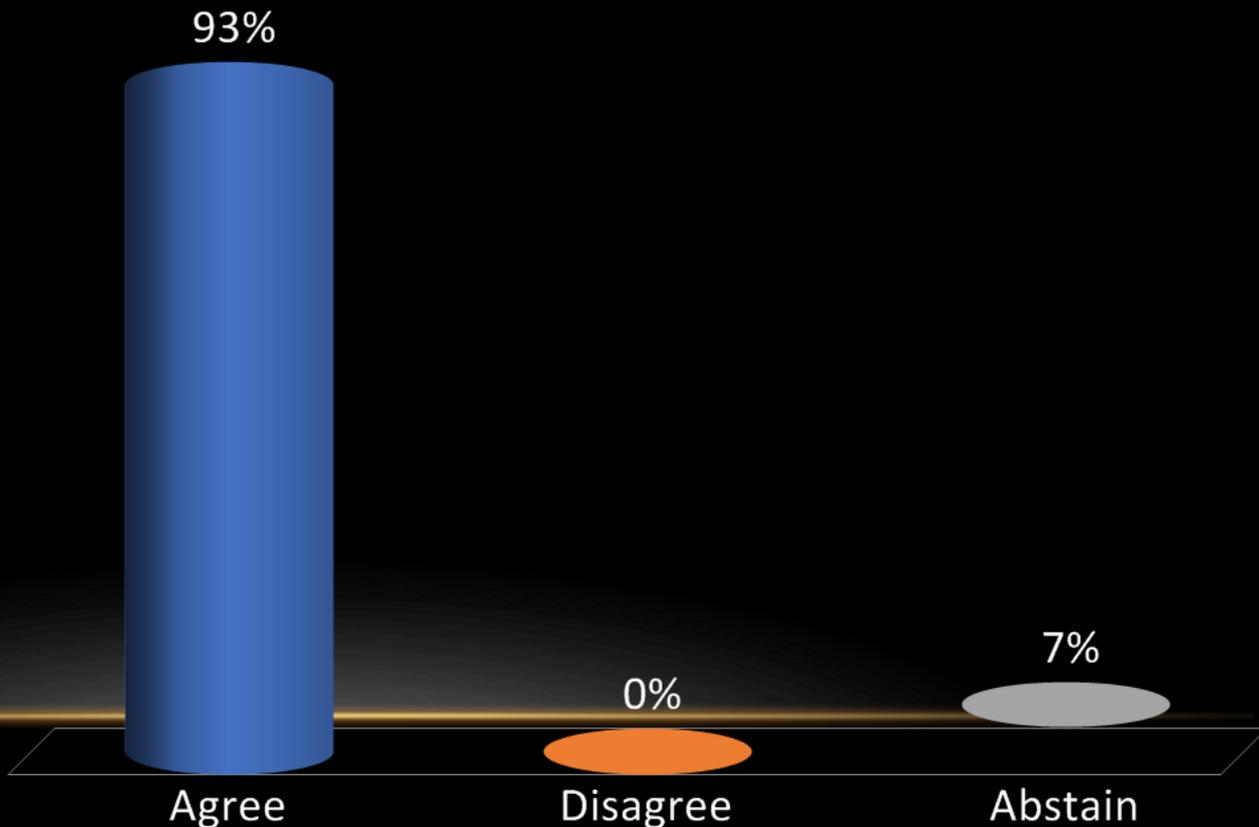
- **Only a single retrospective study is available in the literature providing no evidence**



Recommendation: The use of chronic antibiotic suppression has not been clearly investigated until now. It can be an option on patients whose implants can not be removed or refusing further surgeries because of comorbidities.

Level of Evidence: Consensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-46 (Former Spin-21) Is there a role for combination antibiotics (ie dual or triple) in treating patients with SSI following spinal surgery?

RESEARCHED BY:



Alexander Vaccaro

Anand Segar



Literature:

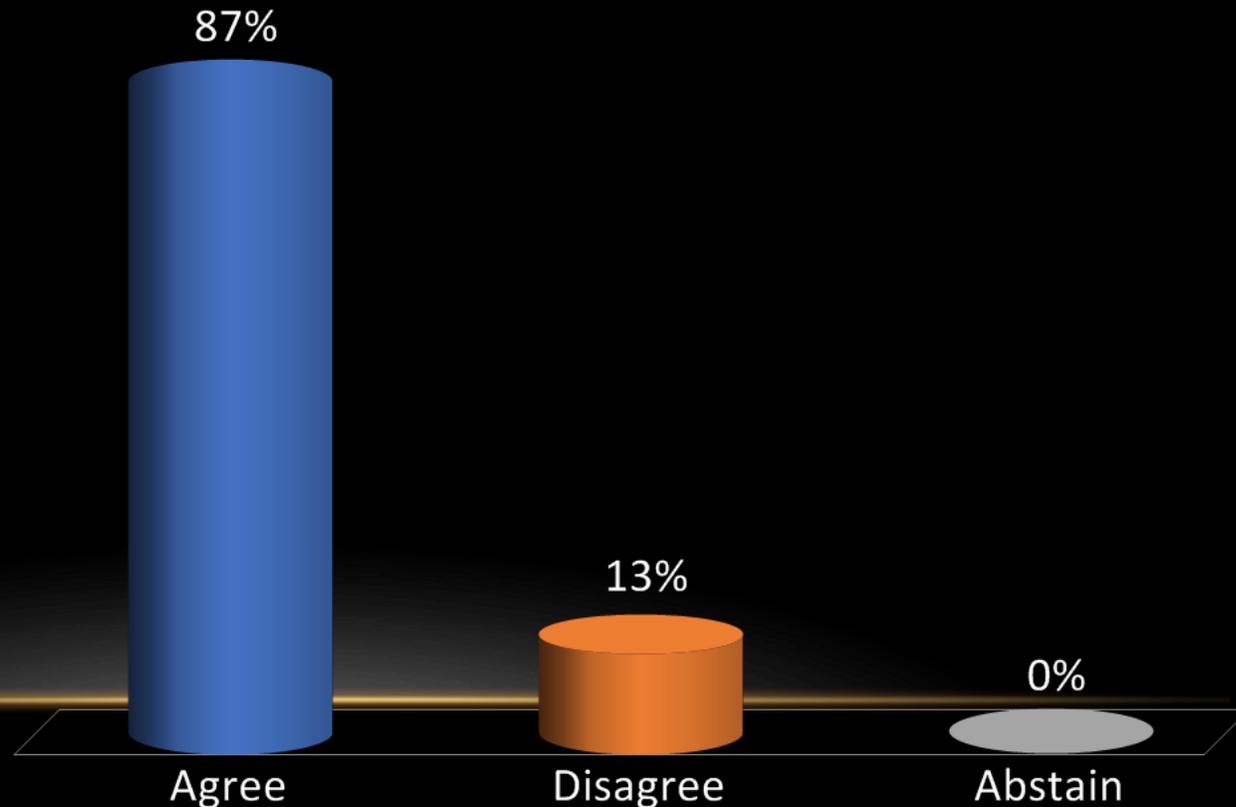
- There is currently no literature available for this topic. Further studies are needed to provide more insight.



Recommendation: There is insufficient evidence to recommend for the routine use of combination antibiotics in the setting of post-operative spine infections. There may be a role for combination antibiotics in certain circumstances related to specific pathogens.

Level of Evidence: Consensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-47 (Former Spin-9) How long should antibiotic be administered after surgical debridement for an acute postsurgical spinal infection?

RESEARCHED BY:



Yvonne Acherman



Literature:

- **Insufficient evidence exists to draw conclusions about antibiotic administration after debridement for acute post-op spinal infection**

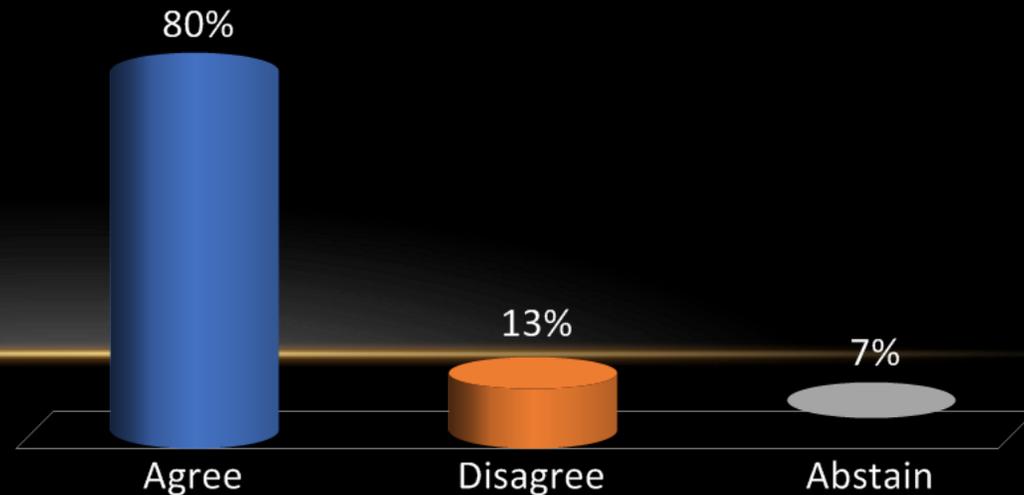


Recommendation: For vertebral osteomyelitis: Initial intravenous treatment for at least 1-2 weeks, followed by an oral treatment of 4-5 weeks to reach a total treatment of 6 weeks.

Deep surgical site infections: There is limited knowledge about the ideal duration of antibiotic treatment and which intravenous and / or oral agents should be given. Extrapolated from studies in periprosthetic joint infections (PJIs) and retrospective studies in spine infections, 12 weeks of antibiotic treatment can be recommended in cases with early infection and implant retention, 6 weeks if implant is removed, and prolonged suppressive treatment in delayed infections without removal of the implant.

Level of Evidence: Moderate for vertebral osteomyelitis
Limited for surgical site infections after spine surgery

- A. Agree
- B. Disagree
- C. Abstain



Spin-48 (Former Spin-10) How long should antibiotics be continued where spinal wounds are left to heal by secondary intention?

RESEARCHED BY:



Gregory Schroeder



Literature:

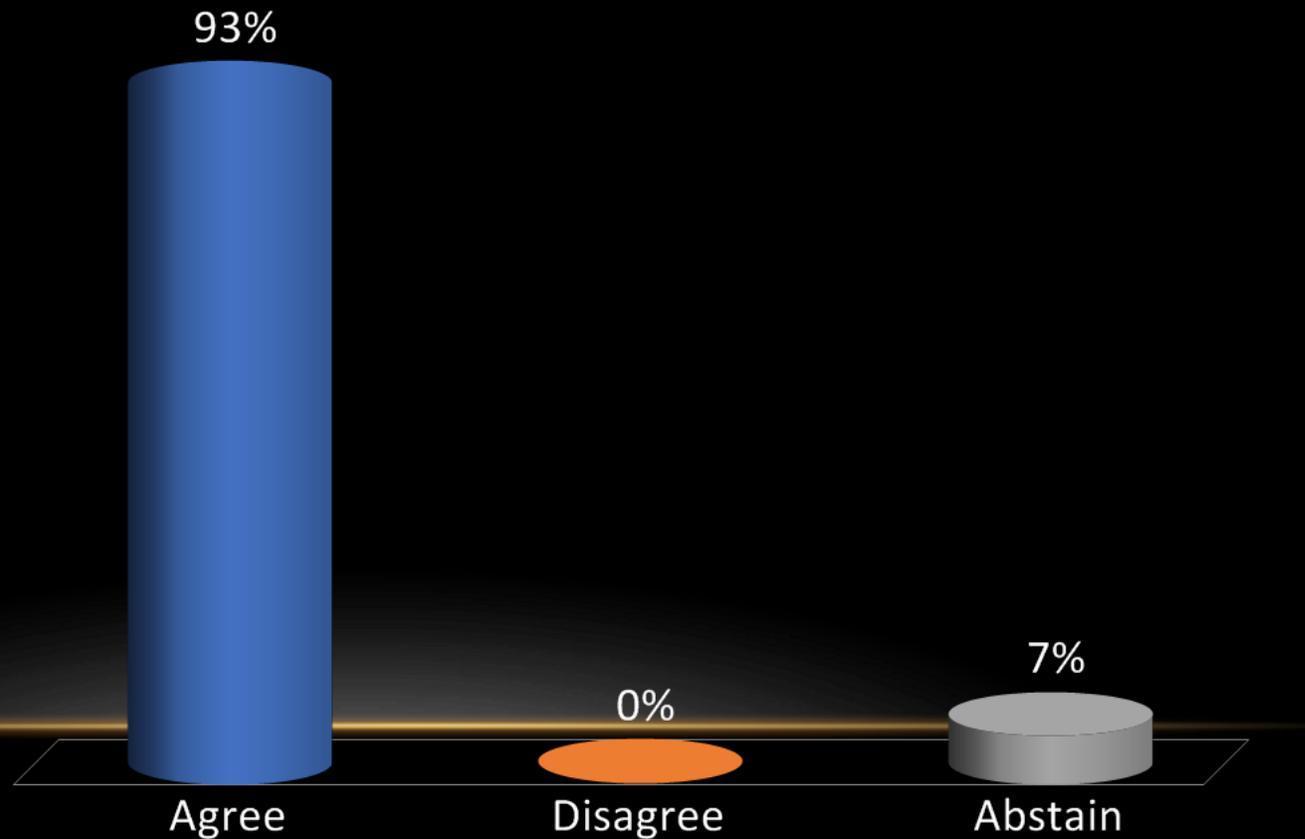
- Evidence is conflicting with both a meta-analysis, RCT, and a retrospective study having different findings therefore no specific conclusions can be drawn currently



Recommendation: Only standard perioperative antibiotic prophylaxis is recommended.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-49 (Former Spin-53) What is the optimal duration of antibiotic treatment following spine infection in patients in whom hardware is retained? Is the antibiotic treatment different for those with spine infection without hardware?

RESEARCHED BY:



Susana Nunez-Pereira

Rabih O. Darouiche



Literature:

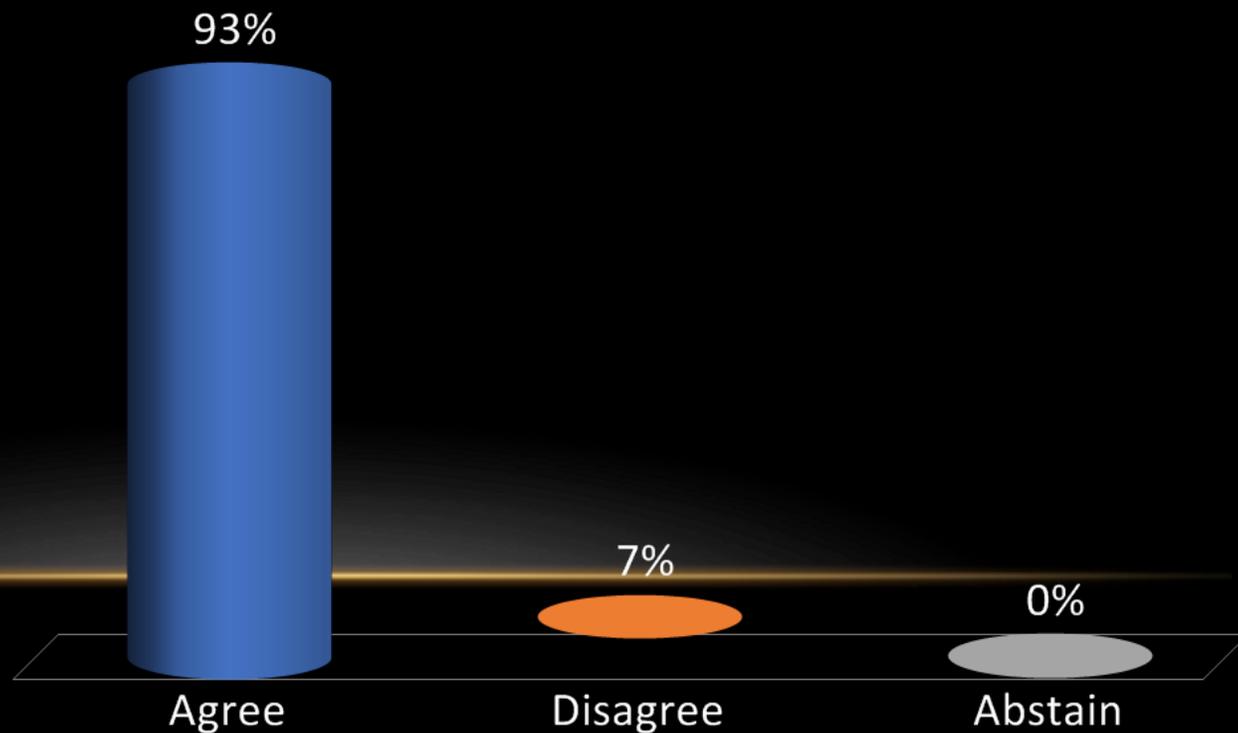
- **Prospective : 1 , Retrospective :13, Randomized: 0, Meta Analysis: 0**
- **The evidence is varied amongst many retrospective studies and a prospective study yielding no evidence.**



Recommendation: There are no case control studies allowing for an evidence-based recommendation on the optimal length of antibiotic treatment following spine infections in the presence of retained hardware. The most commonly implemented antibiotic regime is three months. However, duration of treatment was highly variable among all studies. Patients with non-instrumented surgeries did well with a shorter course of antibiotics.

Level of Evidence: Consensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-50 (Former Spin-60) What tests should be used to monitor response to antibiotic treatment in patients with spine infection?

RESEARCHED BY:



Maja Babic



Literature:

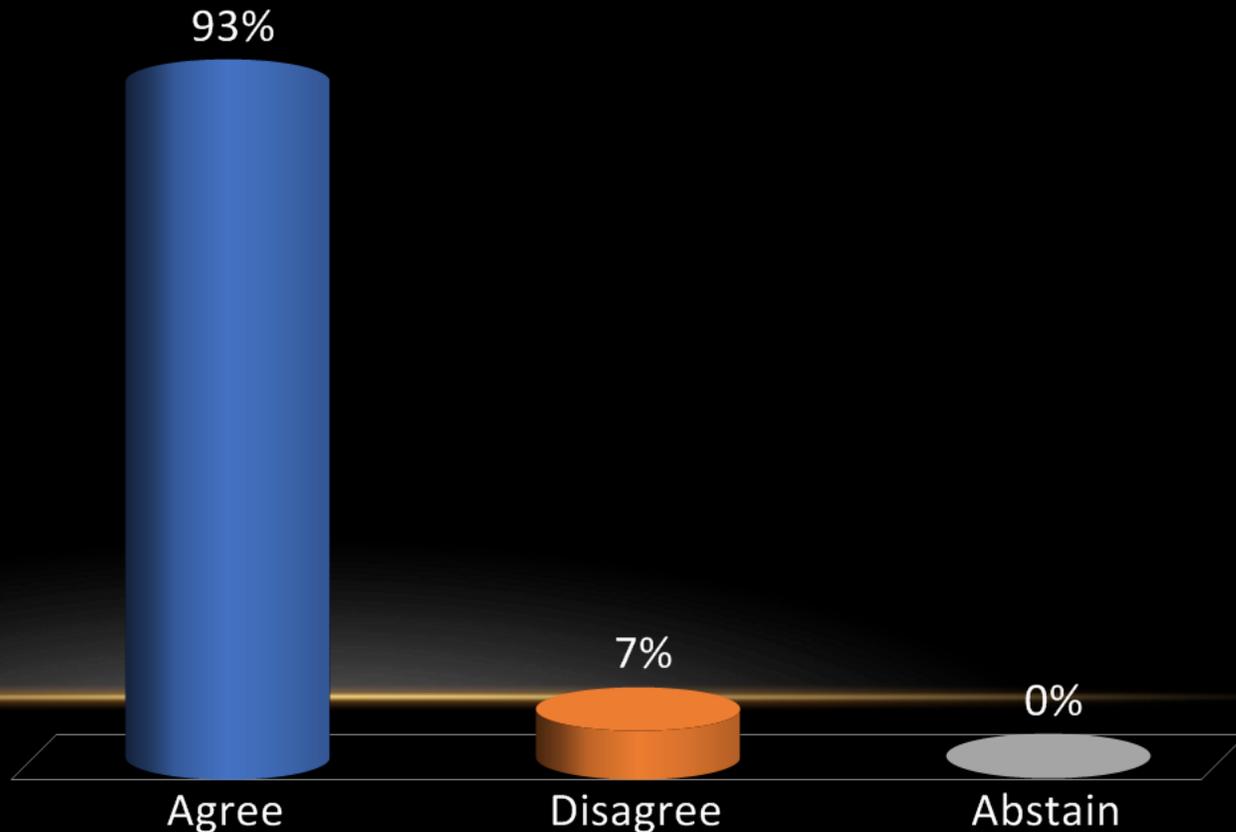
- **Prospective : 1 , Retrospective : 4 , Randomized: 0 , Meta Analysis: 0**
- **Multiple well designed retrospective studies in addition to a prospective study supporting the use of CRP.**



Recommendation: Serum CRP levels are closely related to clinical response in spine infections and are therefore the preferred marker in monitoring the therapeutic course.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Spin-51 (Former Spin-64) Which is the best alternative antimicrobial therapy for fluoroquinolone-resistant gram negative acute post-surgical infection of spinal surgery?

RESEARCHED BY:



Dolores Rodriguez-Pardo



Literature:

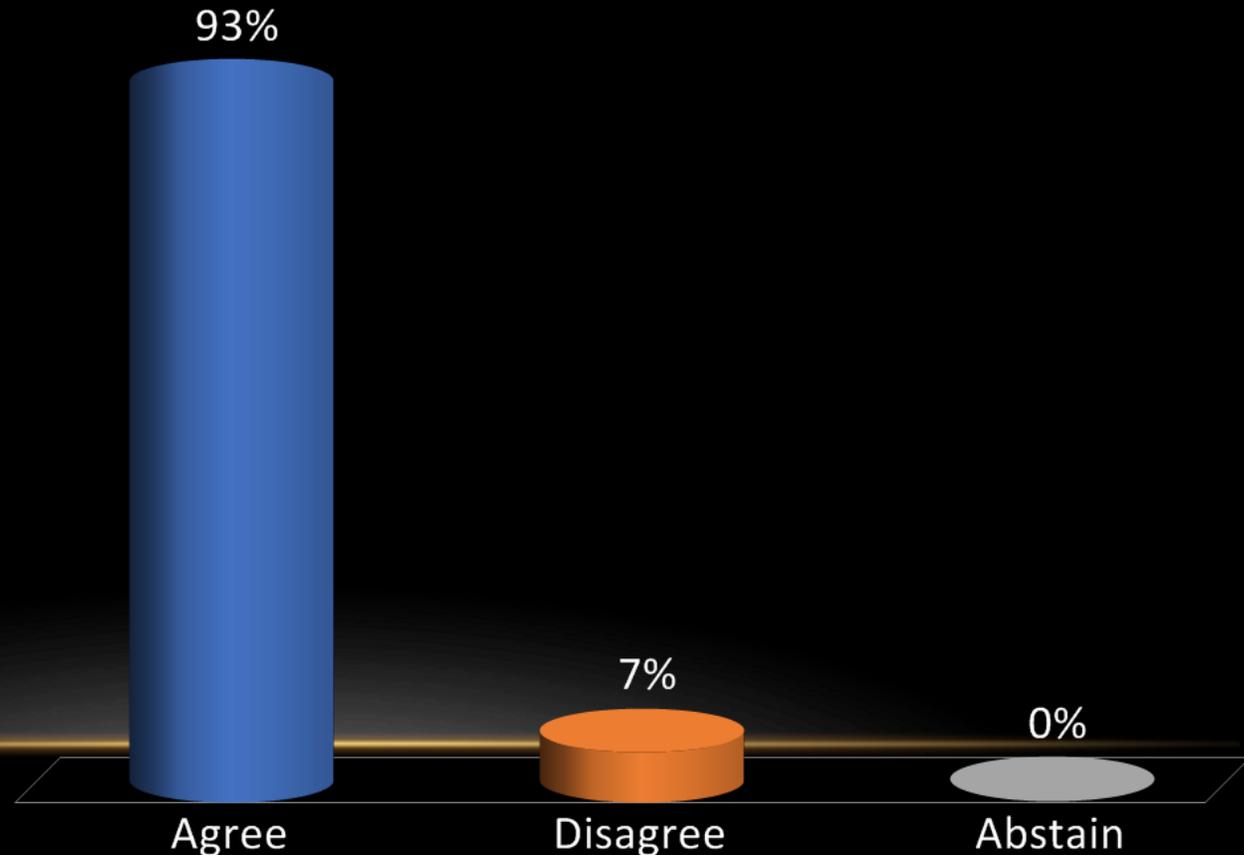
- **Prospective : 1 , Retrospective :3 , Randomized: 0, Meta Analysis: 2**
- **Large multi-center prospective study in addition to well designed retrospective studies and meta-analyses provides moderate evidence for multiple alternative treatment options**



Recommendation: The choice of antimicrobial therapy should be based on the pathogen and the susceptibility profile.

Level of Evidence: Moderate

- A. Agree
- B. Disagree
- C. Abstain



Spin-52 (Former Spin-15) Is negative pressure wound therapy effective in the treatment of wounds that are left to heal by secondary intention?

RESEARCHED BY:

Carles Pigrau, MD



Literature:

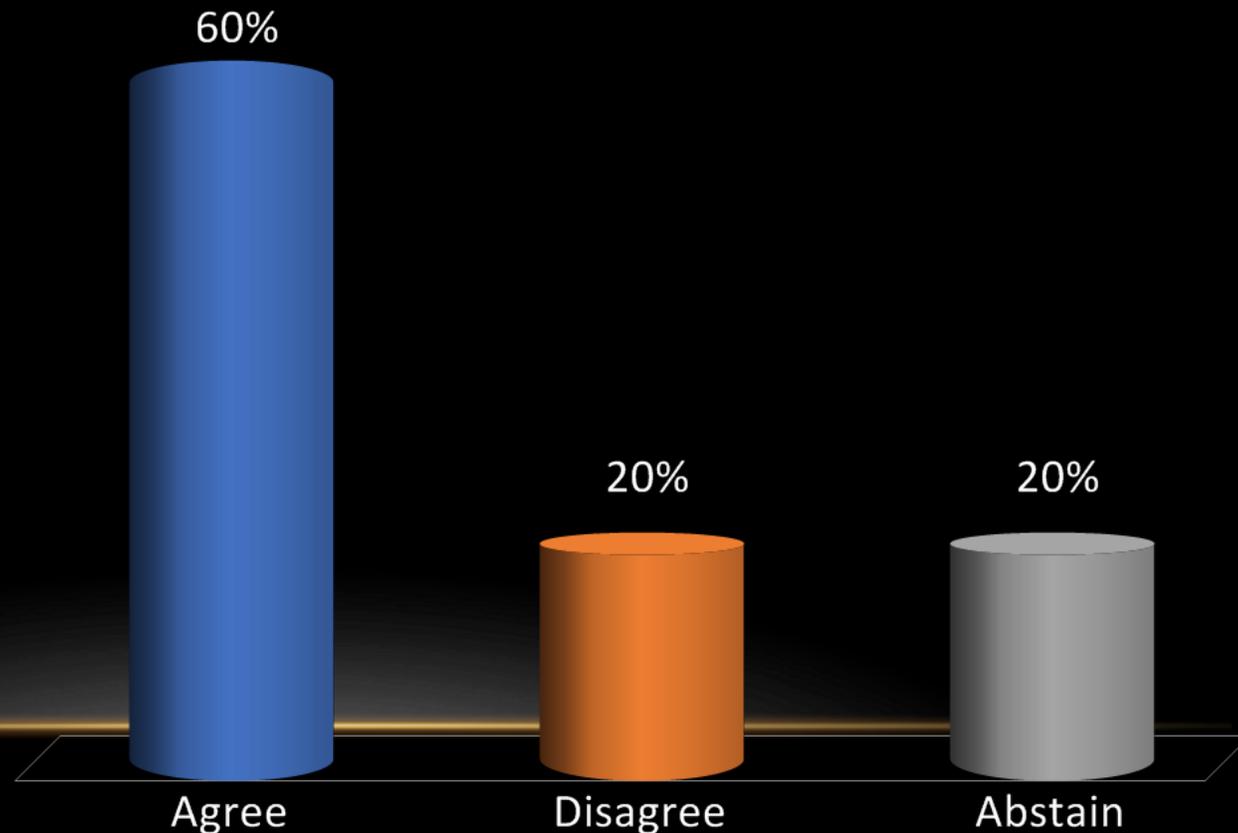
- **No evidence regarding superiority of negative pressure dressings over standard dressing changes.**
- **Meta-analysis supporting the use of NPWT**



Recommendation: There is no evidence that negative pressure wound therapy is superior to conventional dressing changes in the treatment of wounds that are left to heal by secondary intention.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-53 (Former Spin-18) Is there a difference in the efficacy of Vancomycin beads versus vancomycin powder for spinal implant infections?

RESEARCHED BY:



Steven Schmitt, MD



Christopher Kepler, MD



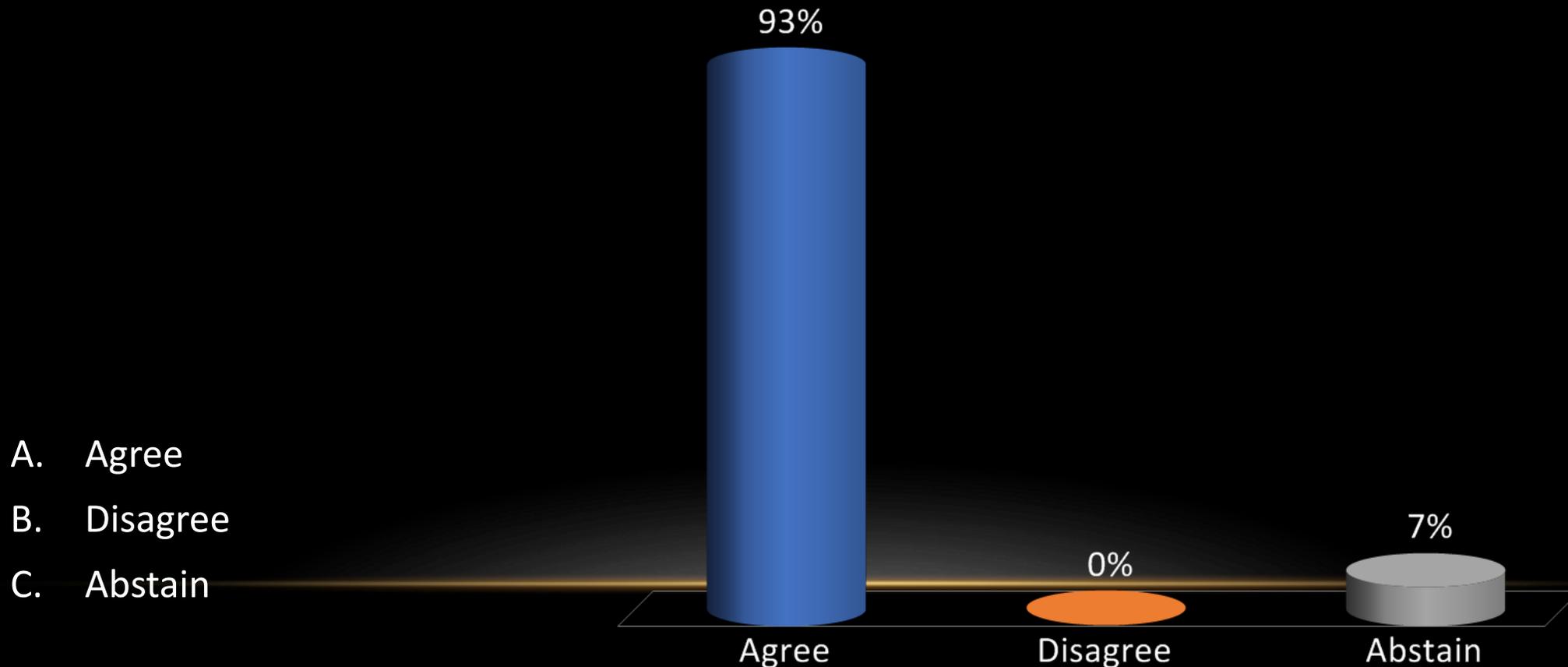
Literature:

- **No studies available in the current literature.**
- **Further investigation in this topic is needed.**



Recommendation: It is unclear whether there is a difference in the efficacy of Vancomycin beads versus Vancomycin powder for spinal implants infections.

Level of Evidence: Consensus



Spin-54 (Former Spin-55) What is the optimal irrigation solution (volume, type, and frequency) during clean or infected spinal surgery cases?

RESEARCHED BY:

Koji Yamada, MD



Literature:

- **No RCTs or observational studies to evaluate incisional wound irrigation. Limited evidence from 3 retrospective showing no association between irrigation and SSI**
- **No prospective or RCT examining volume, type or frequency of irrigation.**
- **2 RCTs and 2 observational studies showing benefit of povidone iodine solution in clean spinal surgeries providing moderate level evidence**



Recommendation: #1 There is insufficient evidence to recommend for or against normal saline irrigation before closure for the purpose of preventing SSI in clean spinal surgery.

#2 There is insufficient evidence to support recommendations for optimal volume, type, and frequency of irrigation to prevent SSI in clean spinal surgery.

#3 Consider the use of irrigation with a sterile aqueous povidone-iodine solution before closure for the purpose of preventing SSI in clean spinal surgery.

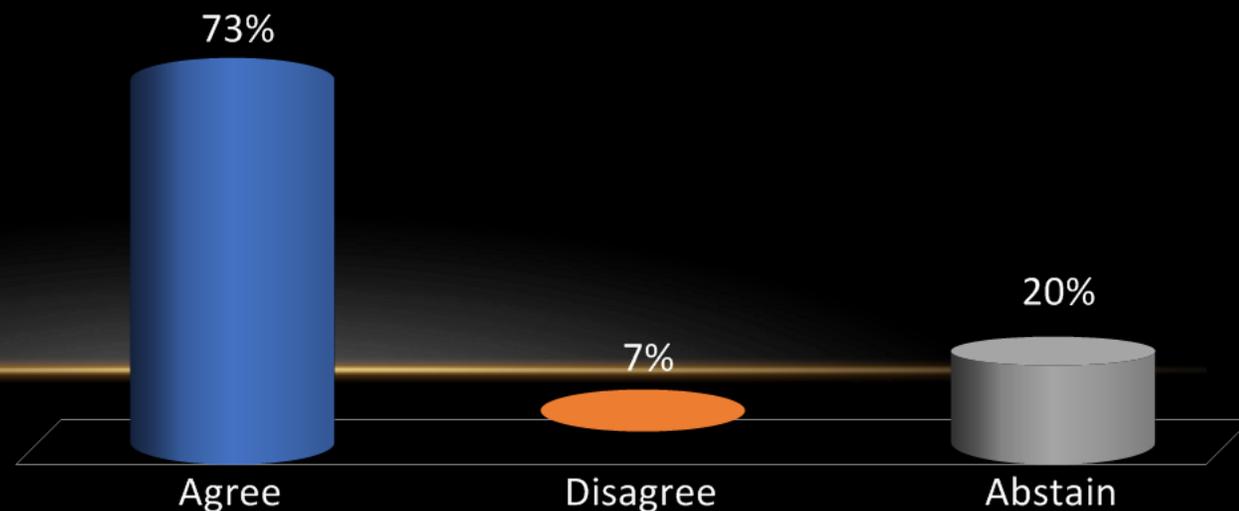
#4 There is insufficient evidence to recommend for or against chlorhexidine and antibiotic solution irrigation of incisional wounds for the purpose of preventing SSI in clean spinal surgery.

#5 There is insufficient evidence to recommend specific solution (volume, type, and frequency) for irrigation in infected spinal surgery.

Level of Evidence: #1: Consensus #2: Limited #3: Moderate

#4: Consensus #5: Consensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-55 (Former Spin-65) Which patients with vertebral osteomyelitis are suitable for outpatient management? Does any criteria exist to aid in decision making?

RESEARCHED BY:



Gregory Schroeder, MD



Dolores Rodriguez-Pardo, MD



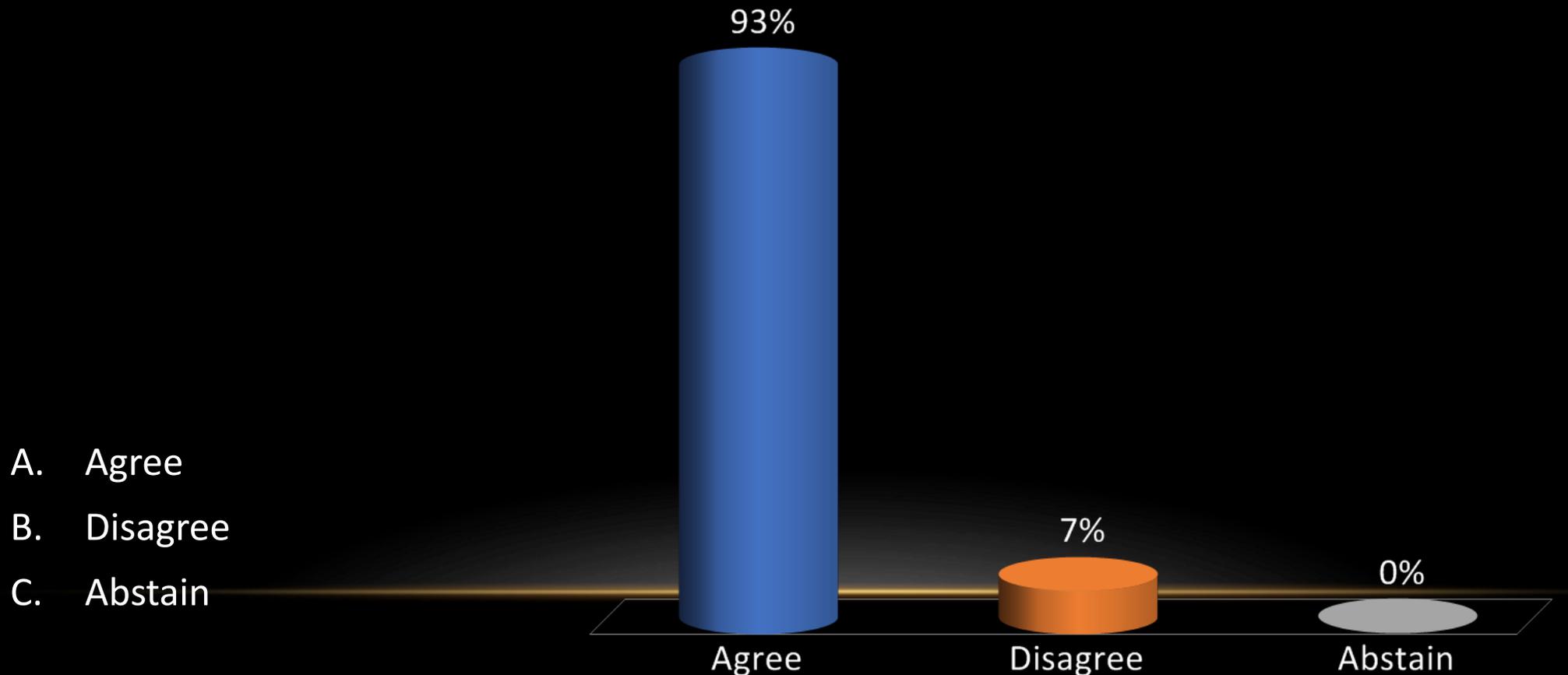
Literature:

- **Prospective: 0 , Retrospective : 4, Randomized: 0, Meta Analysis: 1**
- **Moderate level evidence from multiple retrospective studies in addition to a meta-analysis supporting a switch to oral antibiotics as an indicator for outpatient treatment in vertebral osteomyelitis patients.**



Recommendation: There are no studies addressed to identify which patients diagnosed with vertebral osteomyelitis can be treated on an outpatient basis.

Level of Evidence: Limited



Spin-56 (Former Spin-39) Should infected wounds undergo primary closure or a two stage closure?

RESEARCHED BY:



Gregory Schroeder, MD



Carles Pigrau, MD

Literature:

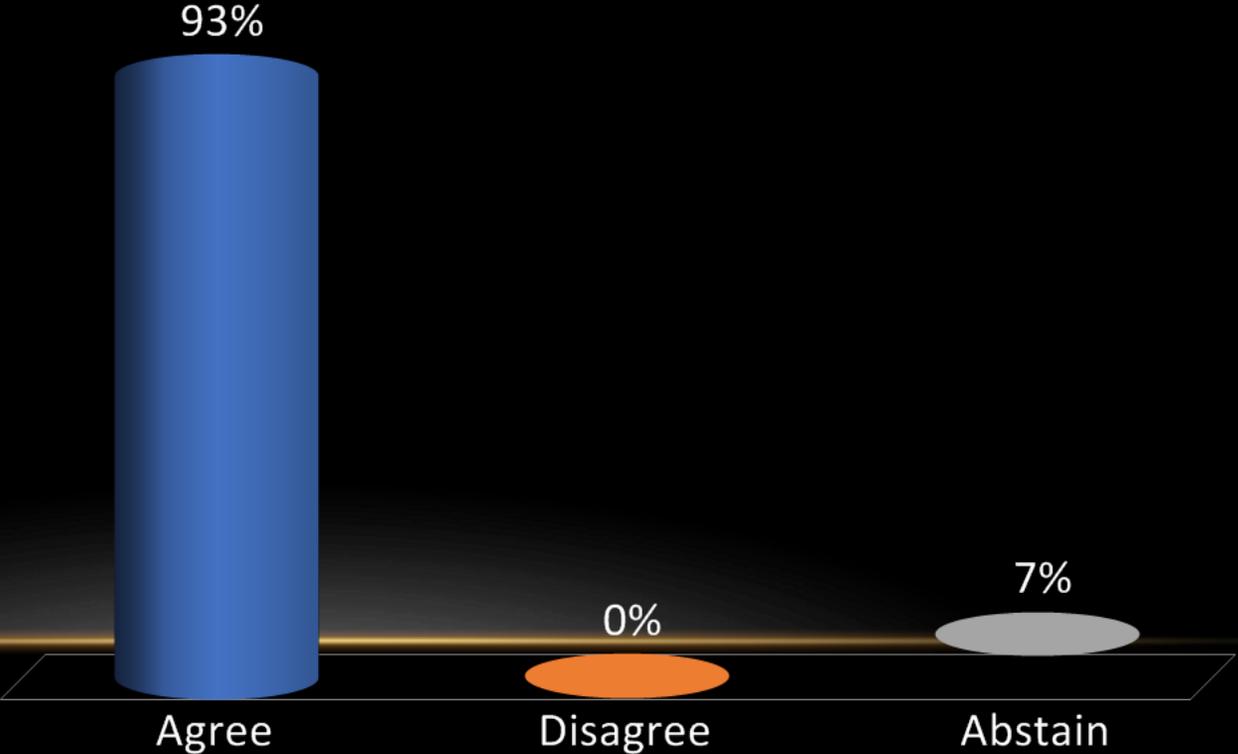
- **No primary studies exist in the spine literature examining primary or two stage closure.**



Recommendation: The current recommended practice for spine wounds remains primary closure in the majority of postoperative infections. However, there may be circumstances when primary closure of the wound may not be possible or preferred. This may include patients with grossly contaminated traumatic wounds, patients with persistent wound drainage when attempts to address drainage have failed and may be in patients with severe soft tissue loss when primary closure is not possible.

Level of Evidence: Consensus

- A. Agree
- B. Disagree
- C. Abstain



Spin-57 (Former Spin-58) What is the optimal treatment of implant related spinal infections caused by *C. acnes* (former *P. acnes*)?

RESEARCHED BY:



Chad Craig, MD



Dolores Rodriguez-Pardo, MD



Literature:

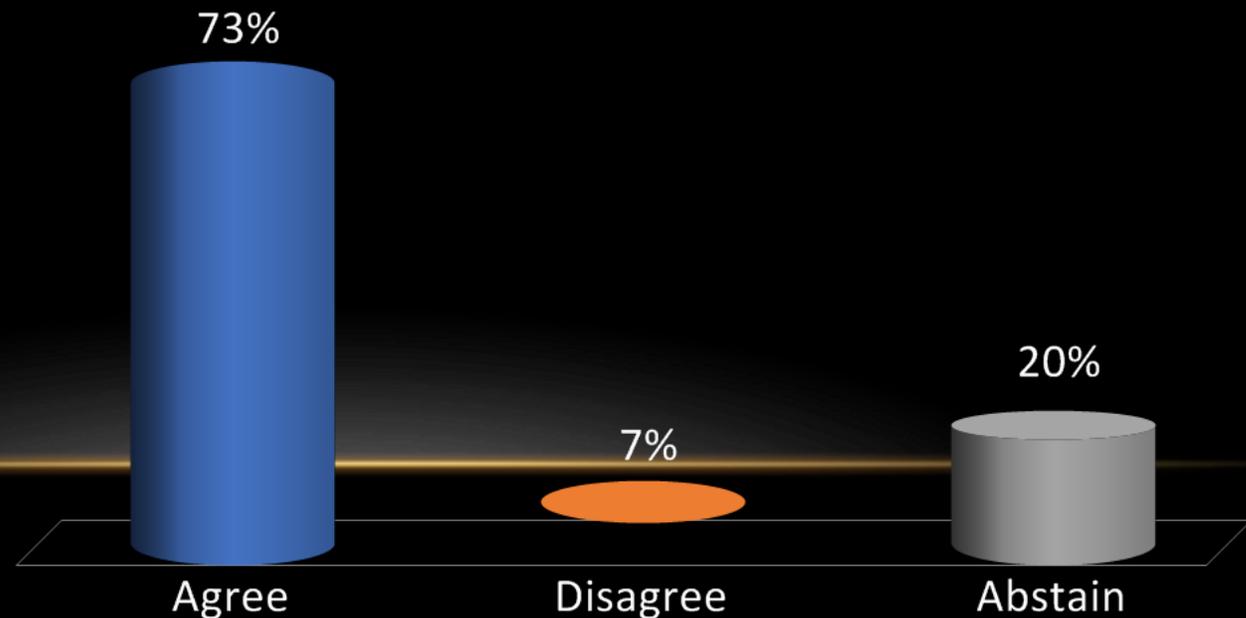
- **Limited evidence on the ideal treatment of spinal infections secondary to *P. acnes* was available.**
- **Available evidence was based on case-reports however no definitive conclusion for optimal treatment could be reached and further study is required.**



Recommendation: When possible, patients should undergo complete removal of implants after *C. acnes* (former *P. acnes*) acnes infection, especially in the setting of latent infection. Antibiotic regimens typically involve specific parenteral antibiotics for a period of greater than 2 weeks, with the most common antibiotic duration being 6 weeks of multiple parenteral and/or oral agents; however, the duration of antibiotic treatment is highly variable. It is unclear in which setting patients may be successfully treated with antibiotic therapy alone and instrumentation may be retained. Penicillin is currently the standard of care, other non beta-lactam antibiotics should be considered based on the susceptibility profile.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-58 (Former Spin-34) Should a cage be removed in patients with postoperative spine infection?

RESEARCHED BY:



Pouya Alijanipour, MD



Literature:

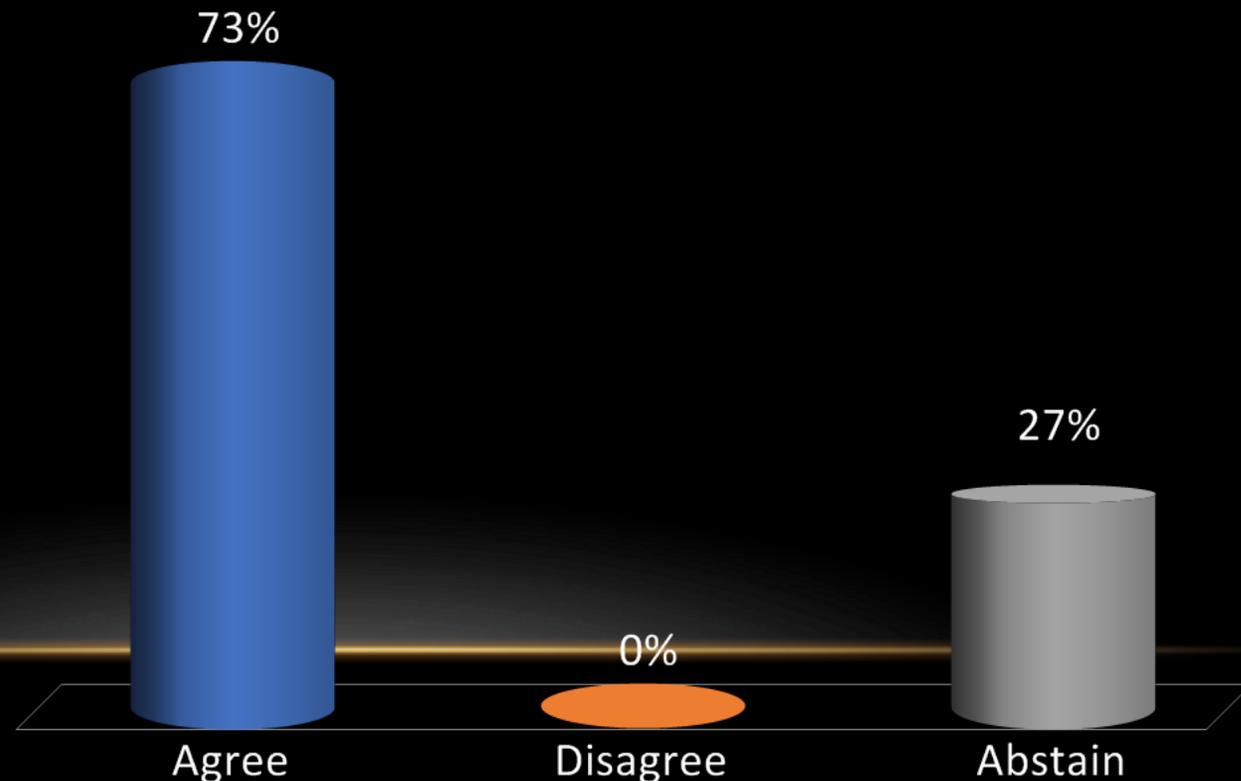
- **Limited data is available and is restricted to retrospective and case series studies providing low-level evidence.**
- **Therefore no definitive recommendations for cage removal can be made.**



Recommendation: No. The interbody cage can be maintained in the absence of clinical and radiographic signs of loosening or displacement of cage or compression on neural and vascular structures. However, the cage should be removed if the infection persists despite salvage attempt consisting of irrigation and debridement procedures combined with intravenous antibiotic treatment.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-59 (Former Spin-19) Is there a length of time of infection beyond which instrumentation should be removed?

RESEARCHED BY:



Christopher Kepler, MD



Barrett Boody, MD



Literature:

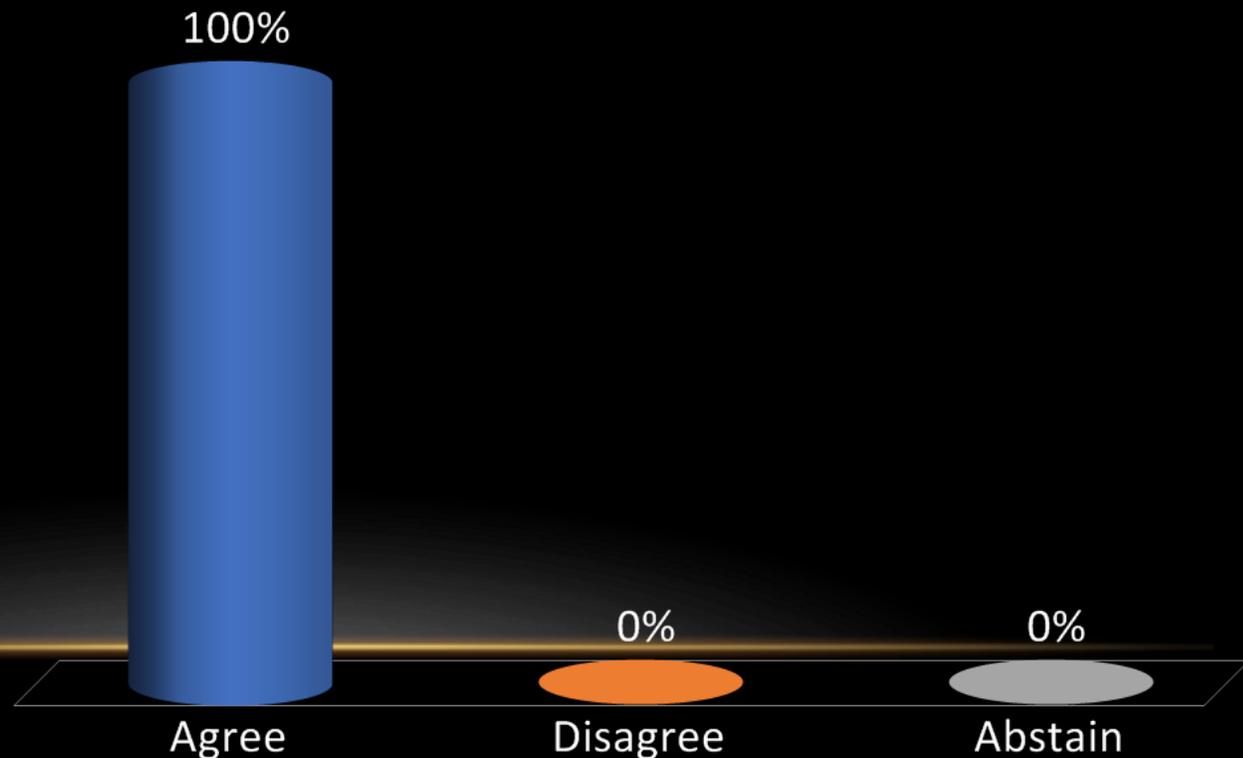
- The vast majority of studies are retrospective multicenter, case-controlled, or case-series.
- No meta-analysis or RCTs were identified
- The heterogeneity of infection duration, surgical debridement, instrumented present, and antibiotic treatment makes drawing specific conclusions difficult.



Recommendation: The data suggests that early infection can commonly be treated with implant retention and debridement followed by IV antibiotics and commonly oral antibiotic treatment. If the patient has achieved spinal fusion, the implants can be safely removed. In the setting of pseudarthrosis, thought should be given to removal of implants to eradicate infection followed by re-instrumentation.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-60 (Former Spin-37) Should bone graft be removed in patients with postoperative spine infection? If yes, should a distinction be made between allograft and autograft?

RESEARCHED BY:



Wesley Bronson, MD



Literature:

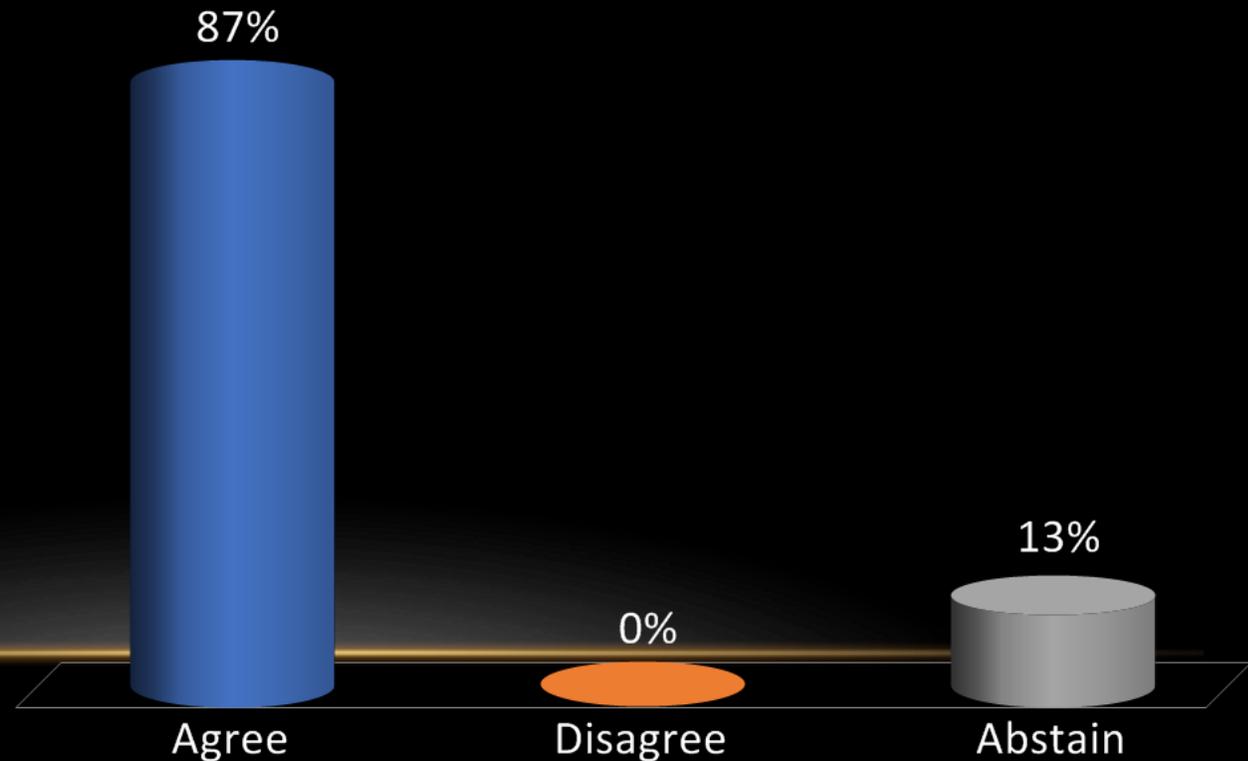
- **No literature could be found that directly stratified patients who had bone graft retained versus removed**



Recommendation: Bone graft need not be routinely removed following irrigation and debridement, especially if partially incorporated. However loose or frankly purulent graft should be considered for removal. Retained allograft may increase the risk for requiring repeat debridement compared to autograft.

Level of Evidence: Limited

- A. Agree
- B. Disagree
- C. Abstain



Spin-61 (Former Spin-44) What are the indications for implant retention or removal of hardware in spinal infections?

RESEARCHED BY:



Yvonne Achermann, MD



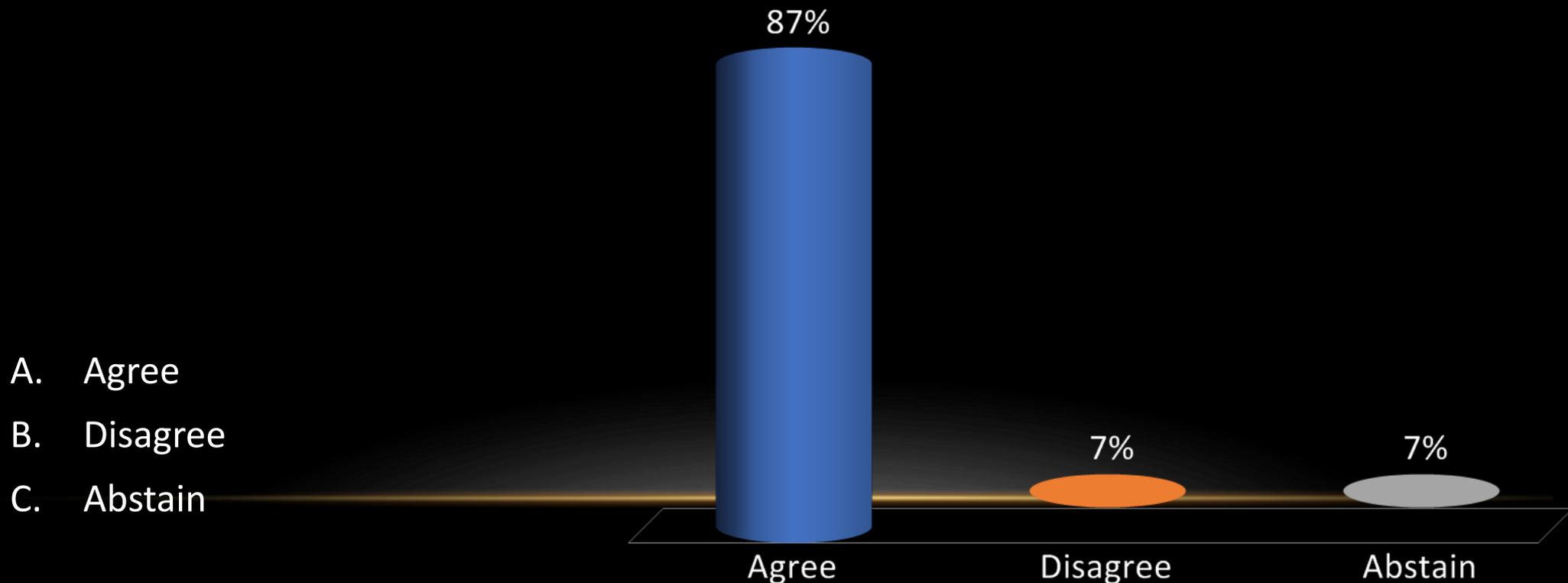
Literature:

- **No level I or II studies exist to address this question**
- **Data is limited to small case-series**
- **Further studies need to be completed with a control cohort, a clear definition for acute vs chronic nature of the infection, and recommendations for dorsal instrumentation or interdiscal implants**



Recommendation: In early or acute infections, debridement with retention of implant might be possible and should always be favored as removal of the implant carries a great risk for non-fusion despite the risk of chronic low-grade infections with possible implant loosening. In late infections, removal is recommended if feasible.

Level of Evidence: Consensus



Spin-62 (Former Spin-25) Is there a role for one-stage exchange of hardware in the presence of spinal infections?

RESEARCHED BY:



Barrett Woods, MD



Maja Babic, MD



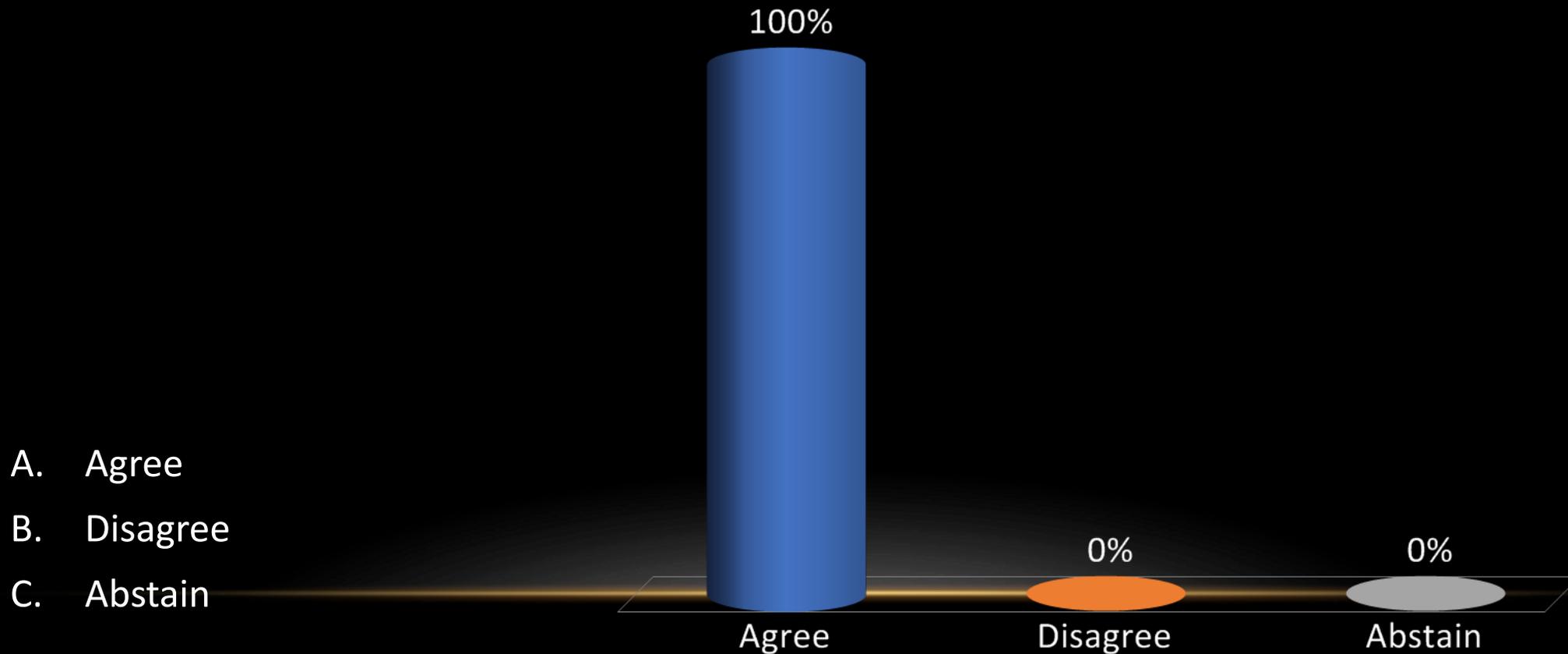
Literature:

- **Data is limited to retrospective cohort and case-series with no RCTS or meta-analysis**
- **The limited data suggest that debridement and implant retention can be performed in acute infections while one-stage exchange needs further evaluation for chronic spine infections**



Recommendation: There is insufficient data on one stage exchange of hardware in the presence of spine infection.

Level of Evidence: Consensus



Spin-63 (Former Spin-52) What is the indication for muscle advancement flaps in patients with spinal infections?

RESEARCHED BY:



Wesley Bronson, MD, USA



Literature:

- **No level I or II studies included**
- **Meta-analysis included case series and retrospective cohort studies**



Recommendation: Muscle advancement flaps are useful to help close wounds with exposed hardware as well as those which fail local treatment/VAC therapy, and to help improve infection eradication.

Level of Evidence: Consensus

