

Proceedings of the Second International Consensus Meeting on Musculoskeletal Infection

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**Published by
Data Trace Publishing Company
P.O. Box 1239
Brooklandville, Maryland 21022-9978
410-494-4994 Fax: 410-494-0515
www.datatrace.com**

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This document on the prevention, diagnosis and treatment of orthopaedic infections is compiled as a result of work of over 800 individuals from around the globe. It is important to note that the text for each question has been composed by individual experts in each field. It is certainly possible that key studies have been overlooked, some points may be emphasized more than other points and each section may suffer from potential individual biases. Nevertheless, the responses to each question have been scholarly researched, evaluated by the majority of the delegates and discussed and voted on during the face-to-face meeting in Philadelphia.

It is important to note that each section does not necessarily represent the personal opinions of Drs. Parvizi and Gehrke, or any individual participating in the Consensus. Therefore, the document should not be interpreted as definitive or in fact represent the “standard of care.” The experts who committed innumerable hours to generate this document have done so in the hopes of improving patient care.

ISBN: 978-1-57400-157-0

We wish to thank the
Orthopaedic Research and Education Foundation
and the
American Association of Hip and Knee Surgeons
for their generous support and for allowing the
publication of the consensus material.



Foreword

The English dictionary defines consensus as a “general agreement about something.” It is seen as the middle ground in decision-making, between total assent and total disagreement. The process of consensus depends on the participants having shared values and common goals. A consensus leads to the generation of an agreement on specific issues that provide overall direction for the future. The Second International Consensus Meeting (ICM) on orthopaedic infections had the above objectives in mind. The second meeting was built on the success of the first ICM meeting that was held in 2013 and implemented additional steps, based on the input of the delegates from the prior meeting, with the intention of improving the outcomes. The second ICM meeting was different in three aspects:

- 1) It included delegates from all subspecialties of orthopaedics including: Hip and Knee Arthroplasty; Foot and Ankle; Oncology; Pediatrics; Shoulder; Elbow; Spine; Sports; and Trauma.
- 2) The consensus was conducted according to the Delphi method again (see below). However, this time instead of having a central group conduct the research and write out the recommendations and rationale for each question, individual delegates were engaged. For each question, the delegates evaluated the available literature, extracted the evidence for current practices and identified the areas in need of further research. The level of evidence related to each “recommendation” was also identified. To the best of our knowledge, no published work related to orthopaedic infections was missed.
- 3) The meeting allowed for the participation of representatives from governmental organizations, payers and business administrations. Although these participants were not allowed to vote in the process, their presence was deemed to be important in developing the road map for funding, supporting and approving technologies related to orthopaedic infections in the future.

The name Delphi derives from the Oracle of Delphi and was developed in the beginning of the Cold War to forecast the impact of technology on warfare. General Henry H. Arnold had ordered the creation of a report for the United States Army Air Corps on technological capabilities that could be used in future warfare. Very soon it became apparent that forecasting methods, technological approaches and quantitative models could not be used, as little “scientific evidence” had been published in this field. To overcome these limitations, the Delphi method was developed by Project RAND during the 1950s and 1960s [1]. The Delphi method continues to be used by the military today and has found its way into the scientific and medical communities [2].

The exact description of the Delphi method that was utilized in the first ICM meeting has been previously published [3] and the document or executive summaries have been published in various venues [4-6]. The second ICM meeting also followed similar steps, with every step of the process being supervised by Dr. William Cats-Baril. The seed for the second consensus meeting was set in soil in June of 2016 when, at the request of many experts from around the world, we decided to proceed. Thirteen specific steps were followed.

Step 1 (August 2016 to December 2016): Selection of Delegates. This step aimed to gather the experts from around the globe, with no country overlooked, who could lend their expertise to the consensus process. The delegates were identified based on their publication track record in the field (at least five publications within the last five years), specialty society nominations or their clinical expertise (high volume) in taking care of patients with orthopaedic infections. The search identified 953 delegates who were sent invitations. Some of the delegates did not respond to the invitation (63) or declined to participate (21), leaving 869 potential delegates to participate.

Step 2 (December 2016 to April 2017): Identification of Issues. The delegates were then asked to send in 5 to 10 questions (issues) in the field of orthopaedic infections that they felt needed to be explored. A total of 3,210 questions were received.

Step 3 (April 2017 to August 2017): Ranking of Questions. The collected questions were then sent to the delegates again and they were asked to prioritize them. In this process, we did not deliberately remove duplicate questions and did not make any changes to the “writing” of the questions. We believed that “duplications” perhaps represented the higher priority of a question.

Step 4 (August 2017 to November 2017): Evaluation of Ranked Questions. Once the ranking had been received, the duplicate questions were removed, and the stem of each question was rewritten according to the Delphi method. This step was necessary to remove “suggestive” phrases such as “what is the role of...?” as opposed to “is there a role...?” This left us with 652 questions that comprised the final set of questions to be explored.

Step 5 (December 2017): **Assignment of Questions.** The final set of questions were then assigned to at least two delegates per question based on the publication track record of the delegate or the desire of a delegate to research a specific question. The delegates were given specific instructions on how to conduct research on the topics presented in each question and how to write up the responses.

Step 6 (December 2017 to March 2018): **Systematic Review.** During this time period, the delegates were actively engaged in researching a specific question and preparing the preliminary document related to each question. The two delegates assigned to each question worked independently for all orthopaedic specialties except for the Shoulder group who decided to work together. No published works in the English language were meant to be missed during this process.

Step 7 (February 2018 to April 2018): **Interdelegate Discussions.** The document received from one delegate was then sent to the other and both delegates were made aware of each other's write up and research. The activity was coordinated centrally to create one document that was acceptable by both delegates. Over 6,000 emails were exchanged during this process alone.

Step 8 (April 2018 to May 2018): **Document Merging/Editing.** All received documents were reviewed, write-ups checked to remove plagiarism, references updated and the English language edited.

Step 9 (June 2018 to July 2018): **Document Evaluation by all Delegates.** Although the documents generated were posted on the website (www.ICMPhilly.com) for many months and available for view by EVERYONE (including the public), the final document was sent to the delegates and they were asked to review any and all questions that were posted live on the website. We received numerous comments from delegates during this period and implemented any and all appropriate changes to the document prior to the meeting.

Step 10 (July 2018): **Final Pre-Meeting Review/Editing.** The entire document was reviewed by the internal editorial team and some additional changes were made. The latest publications, up until June 30, 2018, were also checked and added to relevant sections.

Step 11 (July 25–26, 2018): **Pre-Vote Discussion.** All delegates who traveled to Philadelphia met in their workgroups and discussed some of the questions in their fields. The questions were divided into four categories: 1) Highly clinically relevant with little evidence supporting the recommendation; 2) Highly controversial and clinically relevant; 3) Highly relevant and with great supportive evidence for the recommendation; and 4) Not clinically highly relevant with or without supportive evidence. During the meeting, questions from categories 1 and 2 were discussed.

Step 12 (July 27, 2018). **Voting.** All questions were presented on a screen and the delegates were allowed to vote in real time. The result from voting appeared on the screen shortly after the vote. There were three possible responses to each recommendation: agree; disagree; or abstain. The process of voting was clearly explained by Dr. William Cats-Baril to the delegates prior to voting.

Step 13 (August 2018 onwards): **Dissemination of Consensus Document.** Following the meeting, the voting results were implemented into the document. The document was additionally reviewed by outside editors of Journals, in particular by Dr. Michael A. Mont and his fellow, Dr. Nipun Sodhi, Dr. Thomas Bauer and Dr. Adolph J. "Chick" Yates. The delegates were given the opportunity to review the final document over a four-week period and to provide any additional feedback. All suggested and appropriate changes were implemented into the document. The final document was then sent to various journals for publication as well as for publication in a consolidated book form. The final document is also being translated into different languages.

As can be seen from the above, the delegates were very engaged at every step of the way in generating the consensus document. It is clear, however, that a complex process, like the above, may fall victim to some shortcomings and errors. We made every effort to minimize those as much as possible. We also attempted to be inclusive of all experts from around the world. We are certain that we may have missed some very deserving experts who should have been part of this process. We apologize in advance to any experts who were missed, to the readers who may have to endure some errors in the document, to the authors of reports who may have been missed unintentionally and to anyone else who may feel perturbed because of our shortcomings. We hope that the document that is generated will serve the orthopaedic community for years to come and improve the care of our patients.

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Acknowledgments

A feat of this grandeur cannot happen without the selfless sacrifices of many. The delegates and their coauthors from around the world should be congratulated for producing a unique and useful document that will serve patients for years to come. Their dedication, commitment and passion are very much appreciated. Special thanks to **Tiffany Morrison** who was, without a doubt, THE most critical person for the success of this meeting. Her dedication and the endless efforts to take care of every detail is beyond description. **Allie Martin**, a name recognized by us all, shepherded the effective and timely communications over the two years leading up to the final document, working selflessly to ensure that all the ducks were in a row at all times. Thanks to the **Editorial Team** who read and edited the document numerous times prior to the meeting in order to ensure accuracy and to produce a comprehensible text. Thanks to **Willy Cats-Baril**, the true maestro of the consensus, who kept our feet to the fire at all times ensuring that we complied with the Delphi process, and who beautifully orchestrated the face-to-face meeting. Our gratitude to **Ali Kasemkhani**, our in-house dentist and artist who lent us his artistic expertise in creating the logo, generated visual documentations of the meeting and added many other fine touches to the meeting. We wish to thank our **Industry Partners** for their commitment to our profession and their desire to continuously improve the lives of our patients through innovative tools, techniques and medicines. Their financial support was critical to the success of this meeting and to that we owe them our immense gratitude.

Finally, we want to thank our **wives and children** who allowed us to steal valuable time away from them over the past two years in order to work on the consensus. They were also actively engaged in organizing the social event that generated a successful conclusion to the meeting.

Editorial Board

Special thanks to Dr. Michael A. Mont and his fellow, Dr Nipun Sodhi, who read through the entire document after the July meeting, investing numerous hours editing and checking for accuracy and completeness. We are truly grateful to both of them. Our gratitude also goes out to Dr. Thomas Bauer and Dr. Adolph J. “Chick” Yates, who also spent many hours reading and editing the post-vote document.

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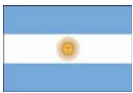
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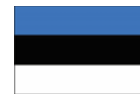
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 Hailer, Nils
 Lazarinis, Stergios
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 Uçkay, Ilker
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Turkey

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United Arab Emirates

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United Kingdom

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 Falworth, Mark
 Foguet, Pedro
 Gambhir, Anil
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 Goswami, Karan
 Grammatopoulos, George
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 Hashemi-Nejad, Aresh
 Heidari, Nima
 Hughes, Harriet
 Jeys, Lee
 Kay, Peter
 Konan, Sujith
 Kunutsor, Setor K.
 Lambert, Simon
 Levy, Ofer
 McNally, Martin
 Meek, Dominic
 Mitchell, Philip
 Montgomery, Alexander
 Murray, James
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 Petrie, Michael J.
 Porteous, Andrew
 Rai, Am
 Reed, Mike
 Saeed, Kordo
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 Sarungi, Martin
 Scarborough, Matthew
 Shivji, Faiz
 Simpson, Hamish
 Stockley, Ian
 Taylor, Adrian
 Thomas, Peter B.
 Toms, Andrew
 Townsend, Robert
 Webb, Jason
 Wilson, Matthew
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Abdel, Matthew
Abraham, John
Adib, Farshad
Aiyer, Amiethab
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Amanatullah, Derek
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Aynardi, Michael
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Barlow, Jonathan
Barnes, C. Lowry
Barrack, Robert
Battenberg, Andrew
Bauer, Thomas W.
Bedair, Hany
Behrend, Caleb
Belden, Katherine
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Benevenia, Joseph
Berry, Daniel
Bingham, Joshua
Bini, Stefano
Blaha, John David
Blaine, Theodore
Blevins, Kier
Booth, Robert E.
Bozic, Kevin
Bradbury, Thomas
Brause, Barry
Bravo, Tricia
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Callaghan, John J.
Castañeda, Pablo
Castillo, Renan
Cats-Baril, William
Chang, Gerard
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Cil, Akin
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Conway, Janet
Cooper, Alexis M
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Cvetanovich, Gregory
Danoff, Jonathan
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Esterhai, John L.
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Freiberg, Andrew A.
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Garrigues, Grant E.
Garvin, Kevin L.
Ghanem, Elie
Giori, Nicholas
Gleason, Brendan
Goel, Rahul
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Goodman, Stuart
Goodman, Susan
Granger, Jeffrey
Green, Andrew
Greenky, Max
Greenwald, A. Seth
Griffin, William
Gutowski, Christina
Hadley, Christopher
Haggard, Warren
Hamlin, Brian
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Hansen, Erik
Harris, Mitch
Hasan, Samer S.
Hendershot, Edward
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Henry, Michael
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Hirose, Christopher
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Hotchkiss, Robert N.
Hsu, Jason
Huang, Ronald
Huddleston, James
Iannotti, Joseph
Indelli, Pier Francesco
Iorio, Richard
Itamura, John
Jennings, Jason

Jennings, Jessica Amber
Jiranek, William
Johnson, Aaron
Johnson, Lucileia
Joshi, Manjari
Kalbian, Irene
Kaplan, Jonathan
Karam, Joseph
Karas, Vasili
Kates, Stephen
Kaye, David
Keener, Jay
Kelly, Jim
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Kepler, Christopher
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Kheir, Matthew
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King, Joseph J.
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Klein, Jason
Klement, Mitchell
Koerner, John
Krebs, Viktor
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Lee, Gwo-Chin
Levine, Brett
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Manson, Theodore
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Marra, Guido
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McFarland, Edward
McLaren, Alex
McLawhorn, Alexander
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Mehta, Samir
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Mihalko, William M.
Miller, Andy O.
Minter, Jon E.
Molloy, Robert
Mont, Michael A.

Moore, Christopher C.
 Morrey, Bernard
 Morrey, Mark
 Morris, Brent
 Moucha, Calin S.
 Muratoglu, Orhun
 Murawski, Christopher D.
 Nam, Denis
 Namdari, Surena
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 Nandi, Sumon
 Natoli, Roman
 Nelson, Charles
 Nelson, Sandra Bliss
 Noble, Philip C
 Nodzo, Scott R
 Nunley, Ryan
 Obremsky, William T.
 O'Donnell, Judith
 O'Donnell, Richard
 O'Driscoll, Shawn
 Odum, Susan
 Oh, Irvin
 Oliashirazi, Ali
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 Orozco, Fabio
 Osmon, Douglas R.
 Otero, Jesse
 O'Toole, Robert
 Padgett, Douglas
 Paolini, Michael
 Paprosky, Wayne G.
 Parekh, Selene
 Parvizi, Javad
 Patel, Nirav K
 Patel, Preetesh
 Patel, Robin
 Patzakis, Michael
 Paxton, E. Scott
 Peat, Raquel
 Pedowitz, David
 Pelt, Christopher E.
 Penna, Sreeram
 Perry, Kevin
 Phillips, K. Scott
 Plancher, Kevin
 Polkowski, Gregory
 Ponzio, Danielle
 Post, Zachary
 Pottinger, Paul
 Poultsides, Lazaros
 Prieto, Hernan
 Pulido, Luis
 Purtill, James J.
 Quinnan, Stephen
 Raikin, Steven
 Ramsey, Matthew
 Randall, R. Lor
 Ricchetti, Eric
 Rihn, Jeffery

Rogero, Ryan
 Romeo, Anthony
 Rondon, Alexander
 Sabesan, Vani
 Saleh, Khaled J.
 Sanchez-Sotelo, Joaquin
 Savoie, Felix H.
 Sawyer, Robert
 Saxena, Arjun
 Schaer, Thomas
 Schlatterer, Daniel R.
 Schmitt, Steven
 Schoch, Bradley
 Schroeder, Gregory
 Schwarz, Edward
 Schwarzkopf, Ran
 Schwechter, Evan
 Scuderi, Giles
 Sculco, Peter
 Segreti, John
 Seyler, Thorsten
 Shahi, AliSina
 Shakked, Rachel
 Sharkey, Peter
 Sheth, Neil
 Shilling, Jack
 Shirliff, Mark
 Shope, Alexander J.
 Sierra, Rafael J.
 Silibovsky, Randi
 Simpfendorfer, Claus
 Smeltzer, Mark
 Smith, Eric B.
 Smith, Eric L.
 Soffin, Ellen M.
 Solomkin, Joseph S.
 Somerson, Jeremy
 Spanghel, Mark
 Sporer, Scott
 Springer, Bryan D.
 Squire, Matthew W.
 Stocks, Greg
 Stoodley, Paul
 Strony, John
 Suarez, Juan
 Suh, Gina Ann
 Suleiman, Linda I.
 Swiontkowski, Marc F.
 Talati, Naasha
 Tan, Timothy
 Tande, Aaron J.
 Tarabichi, Majd
 Tarity, T. David
 Tashjian, Robert
 Throckmorton, Thomas
 Tornetta III, Paul
 Tuan, Rocky S.
 Urish, Kenneth
 Vaccaro, Alexander
 Virk, Mandeep
 Voloshin, Ilya

Vulcano, Ettore
 Ward, Derek
 Warren, David
 Watson, J. Tracy
 Weaver, Michael J.
 Weber, Kristy
 Weistroffer, Joseph K.
 Wellman, Samuel
 Wenke, Joseph
 Whiteside, Leo
 Williams, Dustin
 Williams, Gerald
 Windsor, Russel
 Winters, Brian
 Wongworawat, Montri D.
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 Zmistowski, Benjamin
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Castro, Julio
 Garcia, Gustavo A.
 Grieco Silva, Francisco Rafael
 Limas, Ruben
 Molano, Miguel
 Serrano Fermin, Alberto J.
 Silva, Rosa
 Socorro, Nelson Enrique



Wales

Jones, Stephen
 Morgan-Jones, Rhidian



Yemen

Binlaksar, Ruwais

