

# Cost-effectiveness of single stage surgery of osteomyelitis

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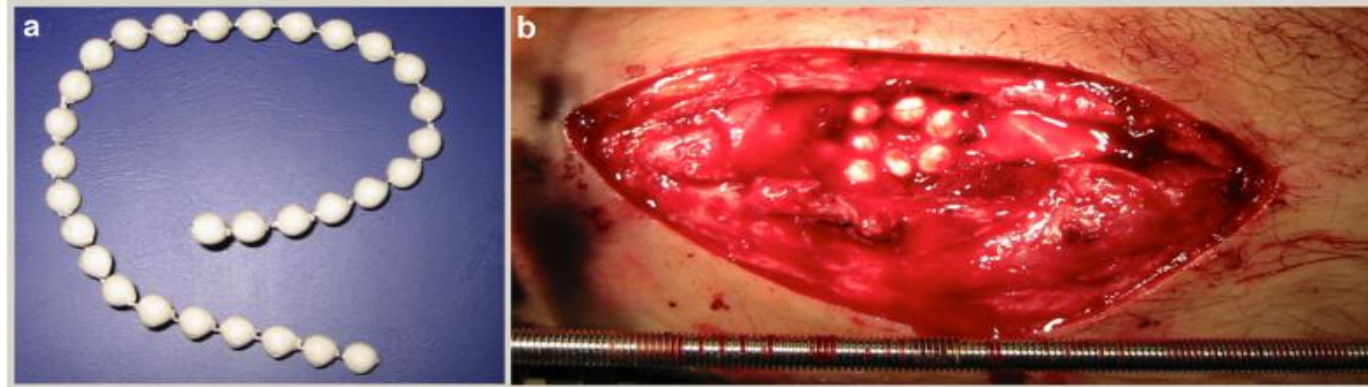
# Disclosures

- Bone Support, Inc.
  - Consultant
- Signature Orthoapedics (Sydney, Australia)
  - Royalty payments for trans-tibial OI system design
- United Orthopedic Corporation, Inc. (Taipei, Taiwan)
  - Royalties and consultant payments for revision total hip arthroplasty system design
- TeDan Surgical Innovations, Inc. (Houston, TX)
  - Royalties for hip arthroplasty retractor system design
- Exactech, Inc. (Gainesville, FL)
  - Royalties and consultant payments for Logic CC revision total knee arthroplasty system design
- Ortho Development Corporation (Draper, UT)
  - Royalties and consultant payments for Ovation Tribute femoral stem design
- Convatec, Inc. (Skillman, NJ)
  - Regional surgical speaker for anti-microbial (Aquacell Ag Surgical) dressing
- Carbo-Fix Orthopedics, Ltd. (Herzeleya, Israel)
  - Consultant and Surgeon Advisory Board Member

For more detailed disclosure information, I refer to the SOMOS App or via the Disclosure Program on the AAOS website

# Management of chronic osteomyelitis

**Two-stage procedure using antibiotic-loaded PMMA spacers plus autograft**



**Other multi-stage procedures**

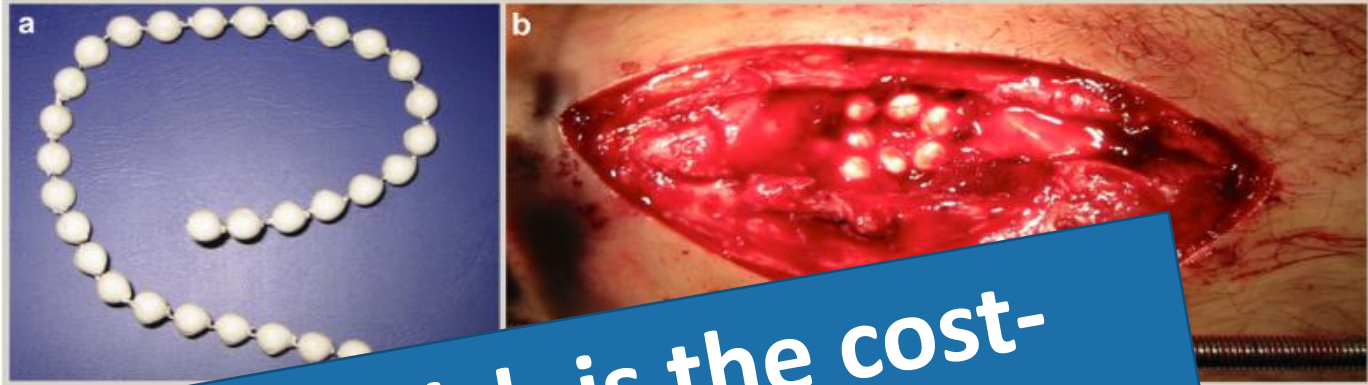
Using the Reamer-Irrigator-Aspirator (RIA) system and antibiotic cement rods  
Flap reconstruction and Ilizarov bone transport  
Débridement plus antibiotic-loaded calcium sulphate pellets  
Débridement and Papineau grafting technique

**Single-stage procedure using an antibiotic-eluting bone graft substitute (CERAMENT G)**



# Management of chronic osteomyelitis

Two-stage procedure using antibiotic-loaded PMMA spacers plus autograft



Other multi-stage procedures

Using t  
Flap rec  
Débride  
Débride

ent rods

Single-stage procedure using an antibiotic-eluting bone graft substitute (CERAMENT G)



**Which is the cost-effective strategy?**  
We hypothesized the single-stage procedure with CERAMENT G

Image reference: Mifsud, M, and M McNally, 'Local Delivery of Antimicrobials in the Treatment of Bone Infections', *Infection*, 33.3 (2019)

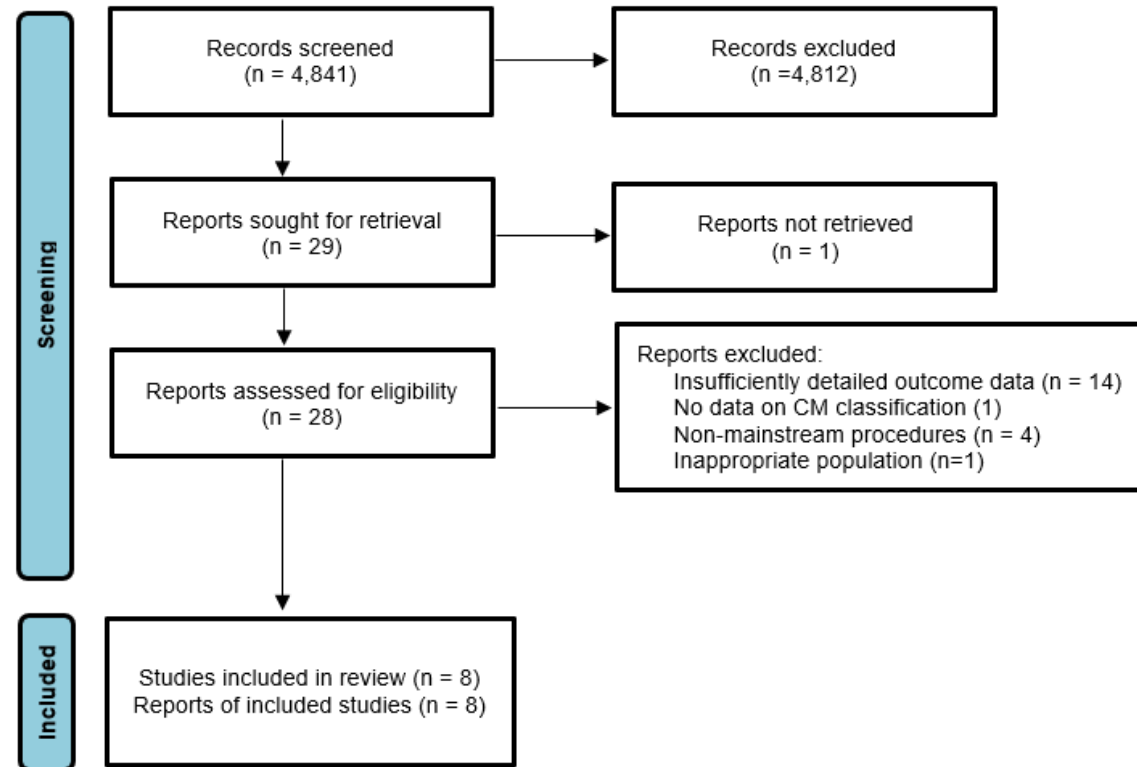
# Cost-effectiveness analysis to compare different approaches

## 1 Systematic literature review and data extraction

*4,841 studies were initially screened*

**366 patients from eight studies provided data**

Figure 1. Literature search flow diagram.



# Cost-effectiveness analysis to compare different approaches

## 2 Model building

*Markov microsimulation approach*

**Simulation of patient journey for two years after surgery for long-bone**

### Data considerations

- Only cases of tibial or femur osteomyelitis were included to maximize comparability
- Timing of procedures and complications were generally available from the studies; however, if missing, data was imputed based upon other study data or most likely time for such events to occur
- Antibiotic regimen is taken where available from the studies; where details are missing, it was assumed that patients would receive three weeks of IV antibiotics followed by 3 months of oral antibiotics after discharge
- Treatment of infection recurrence was standardized based on available data and input from five US-based surgeons.
- Modelling stops at two years because most reinfections occur before then

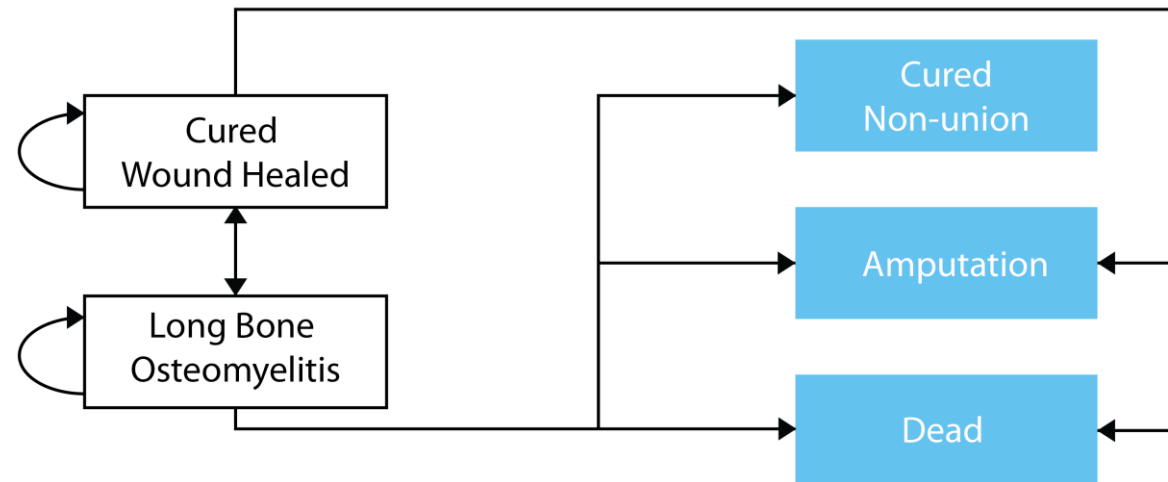
# Cost-effectiveness analysis to compare different approaches

## 2 Model building

*Markov microsimulation approach*

**Simulation of patient journey for two years after surgery for long-bone**

### **Model schematic**



**Cohort size:** 1 million hypothetical patients

**Time horizon:** 2 years

**Cycle length:** 1 month

**Cost perspective:** Healthcare payer (Medicare) in 2021 U.S. dollars

**Costs included:** Inpatient and outpatient wound care provider-based departments (PBDs)



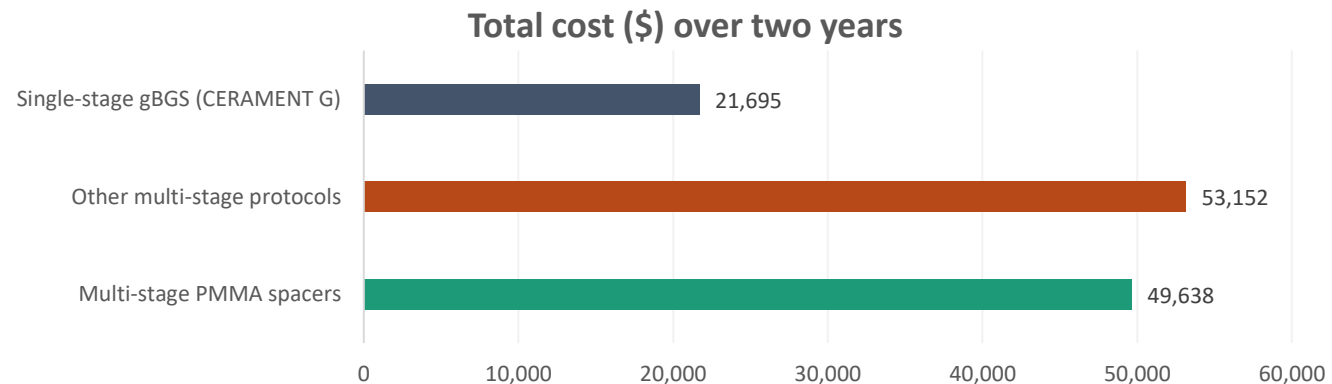
# Cost-effectiveness analysis to compare different approaches

## 3 Results

*Single-stage gBGS (CERAMENT G) has the lowest costs within the two-year time period*

**Substantial cost savings**

	Absolute values			Increment values	
	Multi-stage PMMA spacers	Other multi-stage protocols	Single-stage gBGS (CERAMENT G)	vs. multi-stage PMMA spacers	vs. other multi-stage protocols
Total Cost (\$)	49,638	53,152	21,695	-27,943	-31,457



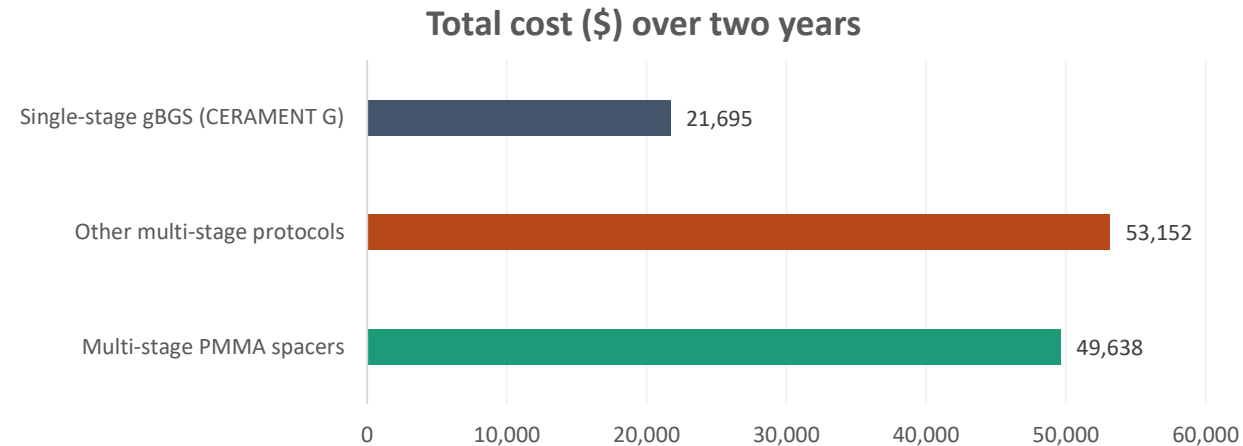


# Cost-effectiveness analysis to compare different approaches

## 3 Results

*Single-stage gBGS (CERAMENT G) has the lowest costs within the two-year time period*

### Substantial cost savings



- Cost reduction is due to less surgeries and less intra- and post-surgical complications
- Probability sensitivity analysis showed that single-stage gBGS lowered cost 96.8% and 98% of the time against both groups

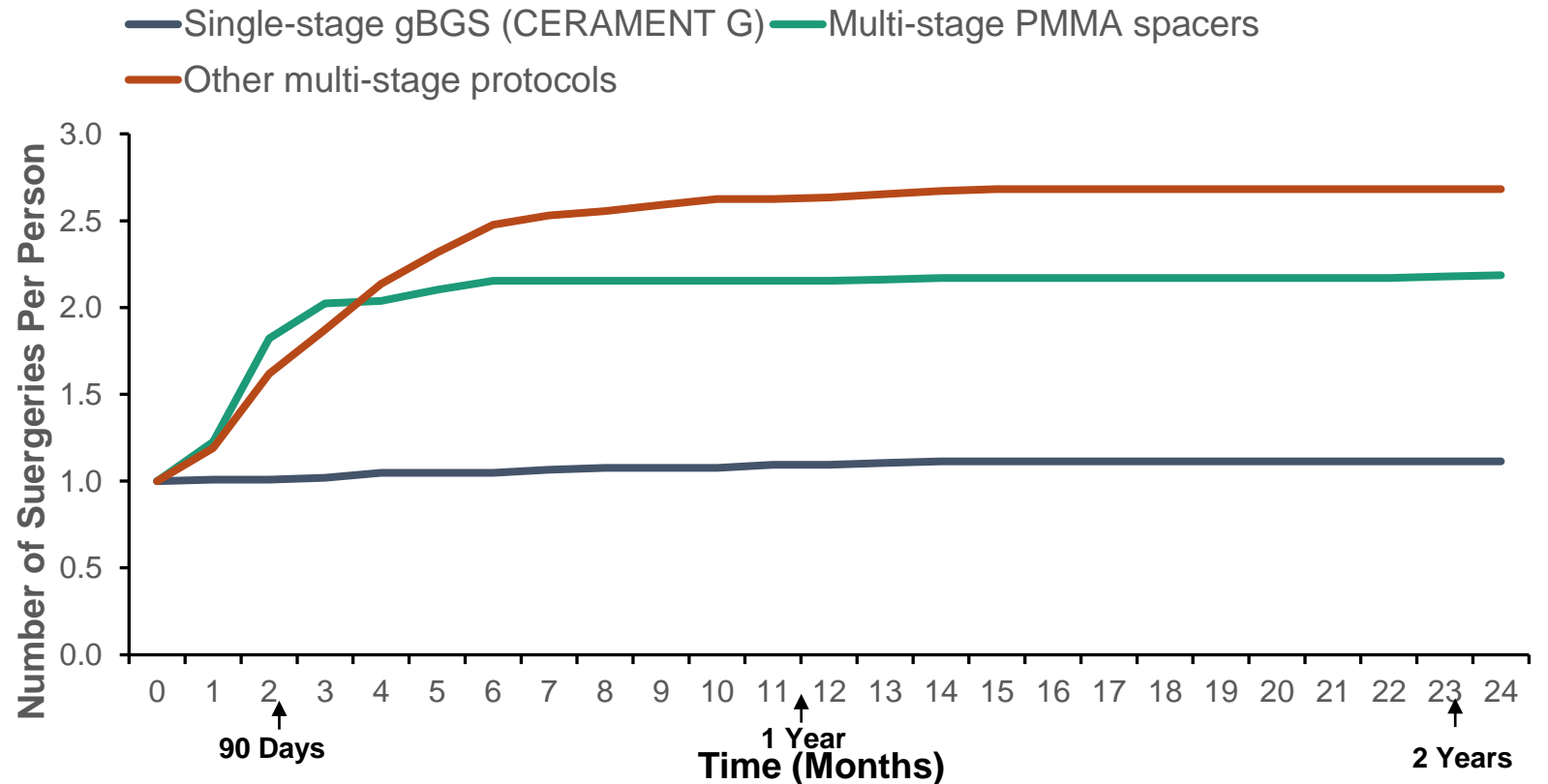
# Cost-effectiveness analysis to compare different approaches

## 3 Results

*Single-stage gBGS (CERAMENT G) has the lowest costs within the two-year time period*

**Substantial cost savings**

**Number of Surgeries, Including Reinfection Per Person Over 2 Years**



# Cost-effectiveness analysis to compare different approaches

## 3 Results

*All groups resulted in an absolute increase in patient quality of life (as osteomyelitis is cured)*

**Small increase in quality-adjusted life years (QALYs)**

	Absolute values			Increment values	
	Multi-stage PMMA spacers	Other multi-stage protocols	Single-stage gBGS (CERAMENT G)	vs. multi-stage PMMA spacers	vs. other multi-stage protocols
QALYs	0.3663	0.3729	<b>0.3761</b>	0.0098	0.0032

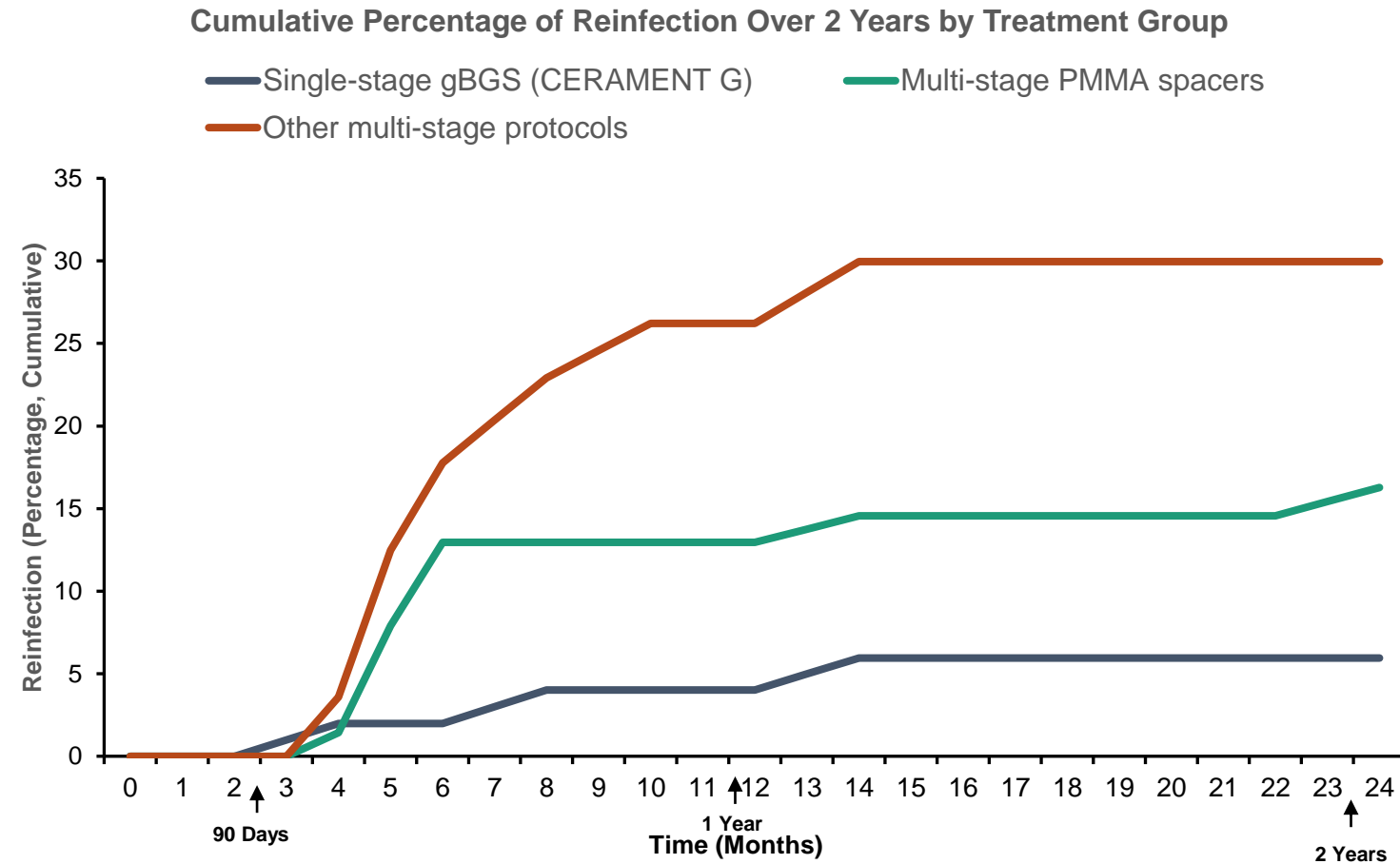
- Although the change in quality of life is relatively small, patients are likely to appreciate shorter treatment times, fewer hospital outpatient visits, and surgical complications, and reinfection rates.

# Cost-effectiveness analysis to compare different approaches

## 3 Results

*Single-stage gBGS maintains low reinfection rate for the next two years*

**Less reinfection with single-stage gBGS**



# Cost-effectiveness analysis to compare different approaches

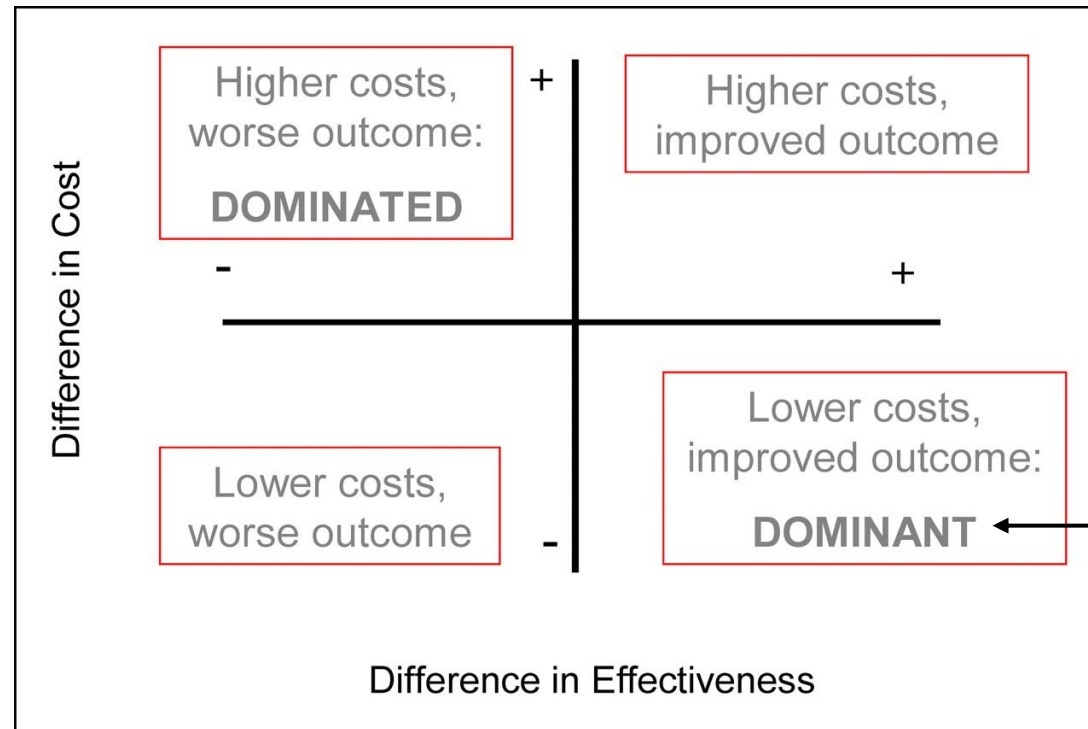
## 3 Results

Dominant Strategy

Base Case

Sensitivity Analyses

*One way*  
*Multiple ways*  
*Probabilistic*



**Single-stage with gBGS (CERAMENT G) compared to the other two groups**

- Re-running the model with different parameters (cost, reinfection, QALY, # of surgeries) did not change the result

# Cost-effectiveness analysis to compare different approaches

## 4 Discussion

- **Weaknesses**
  - PMMA treatments might be different
    - Spacers and Beads lumped together
    - Antibiotic type and concentration may differ
  - Selection bias: ? more extensive cases been treated with multi-stage protocols
- **Strengths**
  - DRG System: proxy for comorbidities, separated femur from tibia
  - Standardized treatment group in Cerament group
- **Comparison with the literature**
- **Future Directions**
  - Prospective, randomized, controlled (vs SOC) studies

# Conclusion

- A single-stage approach with gBGS is a cost-effective strategy to manage chronic osteomyelitis
- Our study suggests that, in patients with Cierny-Mader types III & IV, a single-staged approach might be optimal when treating chronic osteomyelitis
- Prospective investigations are warranted to confirm these findings, particularly on the impact of reinfection and on patient quality of life