

Does single stage surgery of long bone infection using gentamicin-eluting bone-graft substitutes result in decreased cost and improved quality of life compared to traditional approaches?

Carter, M.¹, Calara, P.S.², Diefenbeck, M.², Matuszewski, P.E.³, Agarwal, A.⁴

¹ Strategic Solutions, Inc, Bozeman, MT, USA; mcarter@strategic-solutions-inc.com

² BONESUPPORT AB, Lund, Sweden; samuel.calara@bonesupport.com; michael.diefenbeck@bonesupport.com

³ Department of Orthopaedic Surgery and Sports Medicine, University of Kentucky College of Medicine, Lexington, KY, USA; pmatuszewski@uky.edu

⁴ Orthopaedic Trauma, UT Health San Antonio, San Antonio, TX, USA; Agarwal@uthscsa.edu

Background

- Treatment of bone infection can be accomplished in one or multiple stages.
- Single-stage protocols using a resorbable gentamicin-eluting bone graft substitute (gBGS) have recently shown promising clinical outcomes.
- However, it is unknown whether switching to single stage is a cost-effective strategy compared to having traditional multi-staged approaches.
- **Objective: To investigate the cost-effectiveness of single-stage protocols using gBGS compared to other strategies in the treatment of chronic osteomyelitis (cOM).**

Methods

- A Markov microsimulation model compared healthcare costs and quality-adjusted life years (QALYs) of a cohort of 1 million hypothetical patients using monthly cycles.
- The strategies of antibiotic-loaded polymethyl methacrylate (PMMA) beads plus standard of care (SOC) or other mainstream multi-stage procedures were compared to gBGS plus SOC.
- The model simulated individuals over a two year time horizon with health states of cOM (femur or tibia), wound cured/healed, of dead, amputation, or cured/non-union. Reinfection could place the individual back in the starting health state of cOM (see Figure 1).
- The perspective of the study was the third-party payer and costs were calculated in 2021 U.S dollars in the setting of hospitals, and hospital outpatient wound care provider-based departments (PBDs).
- One-way, multiple ways, and probabilistic sensitivity analyses were conducted to account for variable and parameter uncertainties.

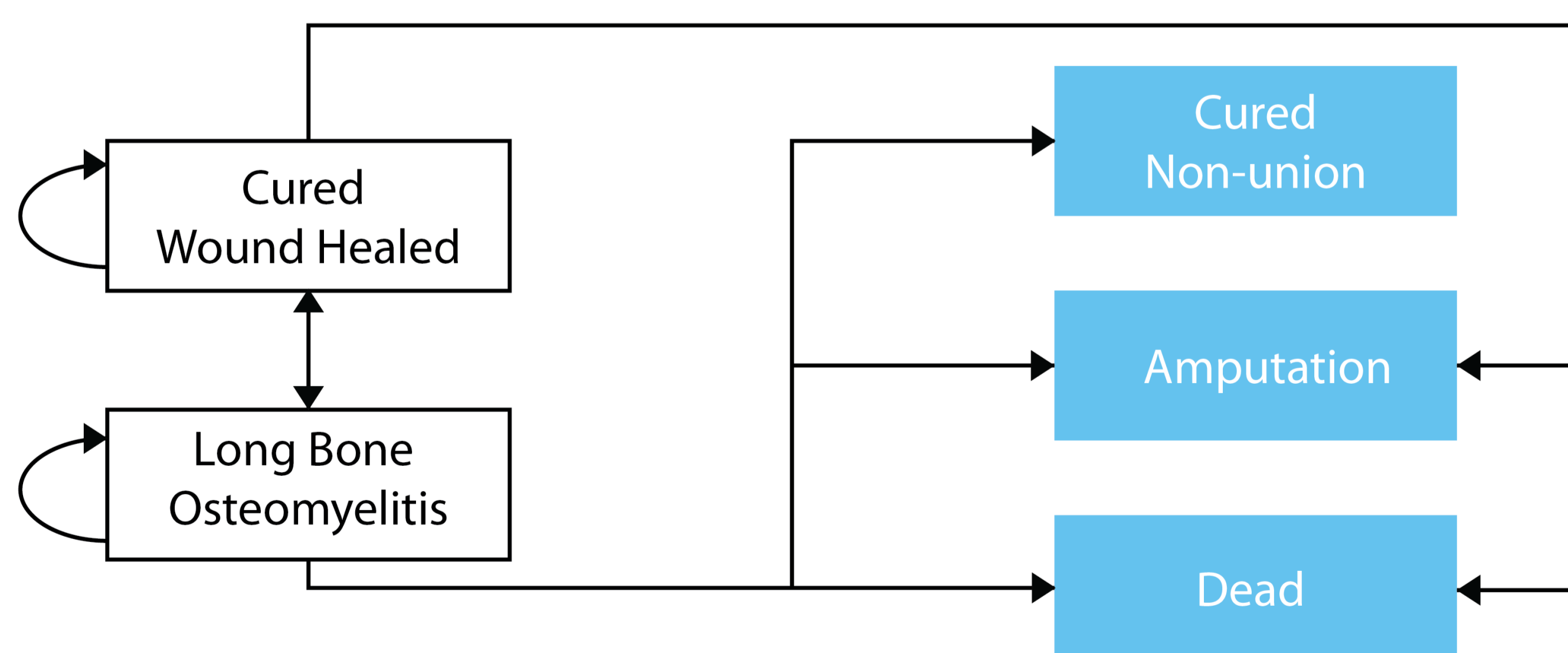


Figure 1. Model Schematic. Arrows indicate possible transitions and boxes indicate health states. Blue-shaded boxes represent absorptive health states.

Conclusion

- A single-stage approach with gBGS for treatment of chronic osteomyelitis likely results in substantial cost savings and a small increase in QALYs compared to traditional multi-stage approaches.
- The cost reduction is due to less surgeries and less intra- and post-surgical complications.
- Prospective investigations are warranted to confirm this finding particularly on the impact of reinfection on patient quality of life.

Table 1. Cost-effectiveness results

	Absolute			Increment	
	Multi-stage PMMA beads	Other multi-stage protocols	Single-stage gBGS	vs. multi-stage PMMA Beads	vs. other multi-stage protocols
QALYs	0.3663	0.3729	0.3761	0.0098	0.0032
Total Cost (\$)	49,638	53,152	21,695	-27,943	-31,457
- First- and second-stage surgeries	25,419	23,151	16,371	-9,048	-6,780
- Antibiotic medication	9,314	18,986	1,486	-7,828	-17,500
- Infection recurrence	771	1,451	270	-501	-1,181
- Amputation-related costs	6,773	1,091	1,771	-5,002	680
- Physical therapy and other outpatient visits	2,402	4,688	1,358	-1,044	-3,330
- Other complications	4,959	3,785	439	-4,520	-3,346
ICER				Dominant	Dominant

Note. Costs in 2021 US dollars. gBGS indicates gentamicin-eluting bone graft substitute (CERAMENT® G); ICER, incremental cost-effectiveness ratio; PMMA, polymethyl methacrylate; QALY, quality-adjusted life years.

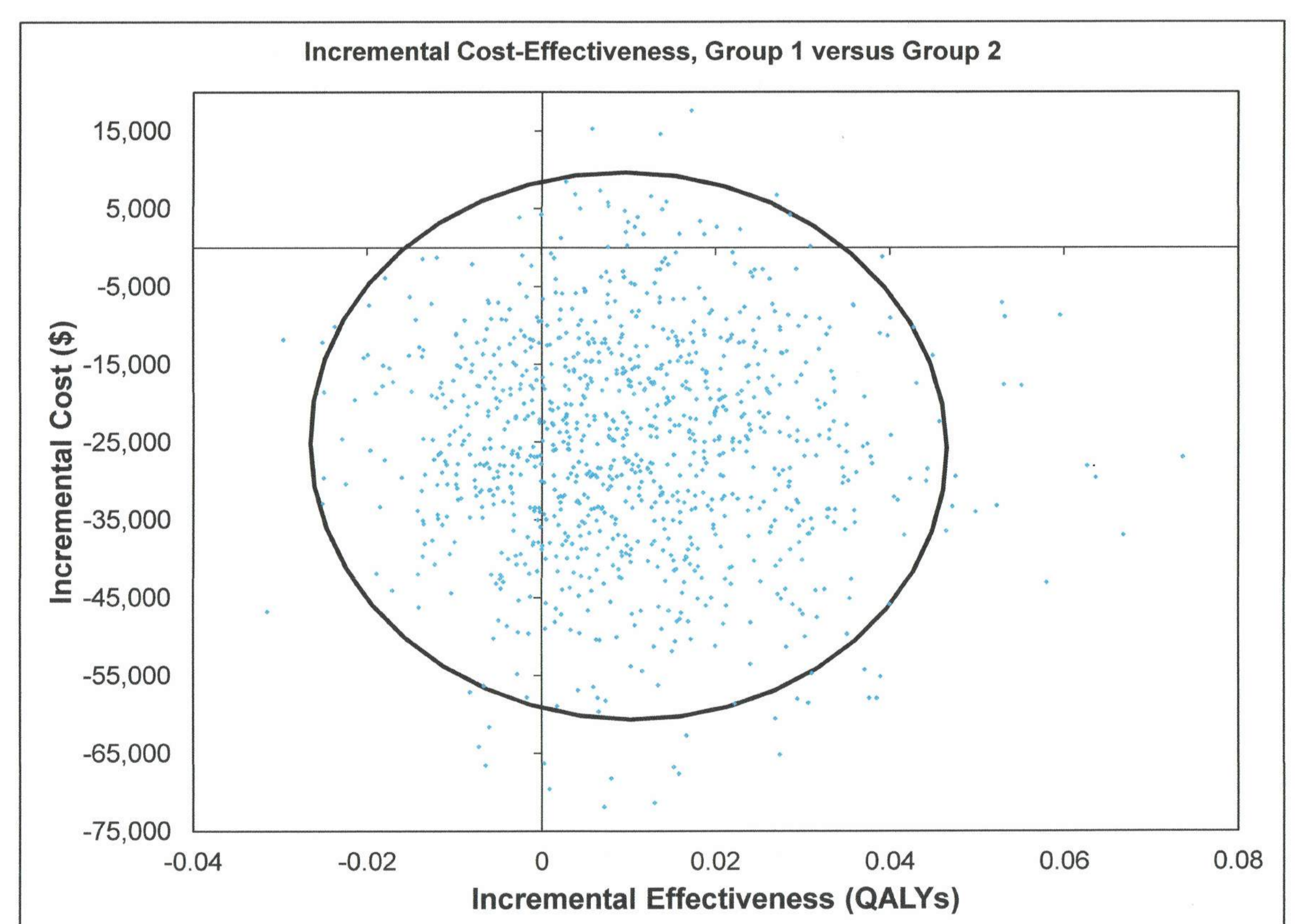


Figure 2. Incremental Cost-Effectiveness: Single-stage protocol with gentamicin-eluting bone graft substitute (gBGS) (Group 1) vs. multi-stage protocol with antibiotic-loaded polymethyl methacrylate (PMMA) beads (Group 2)

References

1. Ferguson, J, Athanasou, N, Diefenbeck, M, McNally, M. Radiographic and histological analysis of a synthetic bone graft substitute eluting gentamicin in the treatment of chronic osteomyelitis. *J Bone Jt Infect.* 2019;4(2):76–84.
2. van Vugt, TAG, Arts, JJ, Geurts, JAP. Antibiotic-loaded polymethylmethacrylate beads and spacers in treatment of orthopedic infections and the role of biofilm formation. *Front Microbiol.* 2019;10:1626.
3. Ferguson, J, Diefenbeck, M, McNally, M. Ceramic biocomposites as biodegradable antibiotic carriers in the treatment of bone infections. *J Bone Jt Infect.* 2017;2(1):38–51.
4. Chung, KC, Shauver, MJ, Saddawi-Konefka, D, Haase, SC. A decision analysis of amputation versus reconstruction for severe open tibial fracture from the physician and patient perspectives. *Ann Plast Surg.* 2011;66(2):185–91.
5. Dobson, A, Murray, K, Manolov, N, DaVanzo, JE. Economic value of orthotic and prosthetic services among medicare beneficiaries: a claims-based retrospective cohort study, 2011–2014. *J Neuroeng Rehabil.* 2018;15(Suppl 1):55.