

Effectiveness of Surface Modified Antimicrobial Implants in Treatment or Prevention of Periprosthetic Joint Infections Post Knee Replacement Surgery: A Systematic Literature Review

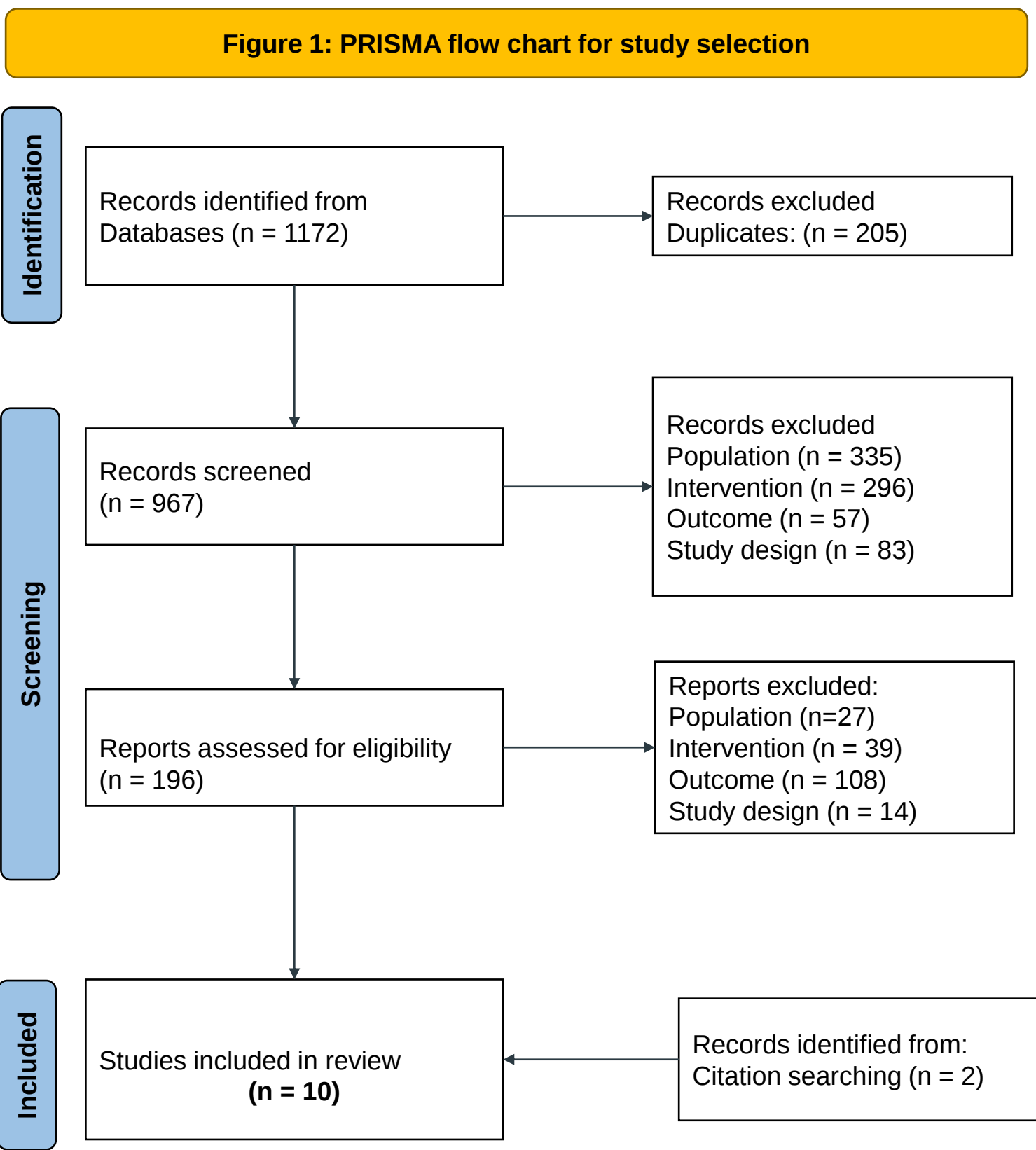
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Introduction

Significant percentage of patients undergo revision surgeries to treat infections that colonize the surface of the joint
Nearly 2% of total knee/hip arthroplasties results in periprosthetic joint infection (PJI) that affects patients’ quality of life
Implant infection is a very severe complication in orthopedics, resulting in implant failure, osteomyelitis and septic arthritis.
The frequency of periprosthetic infections after arthroplasty ranged between 3% and 15%, respectively.
Surface modification of implants with antimicrobial materials may provide an efficient method of prevention and treatment of implant-associated infections

Methodology

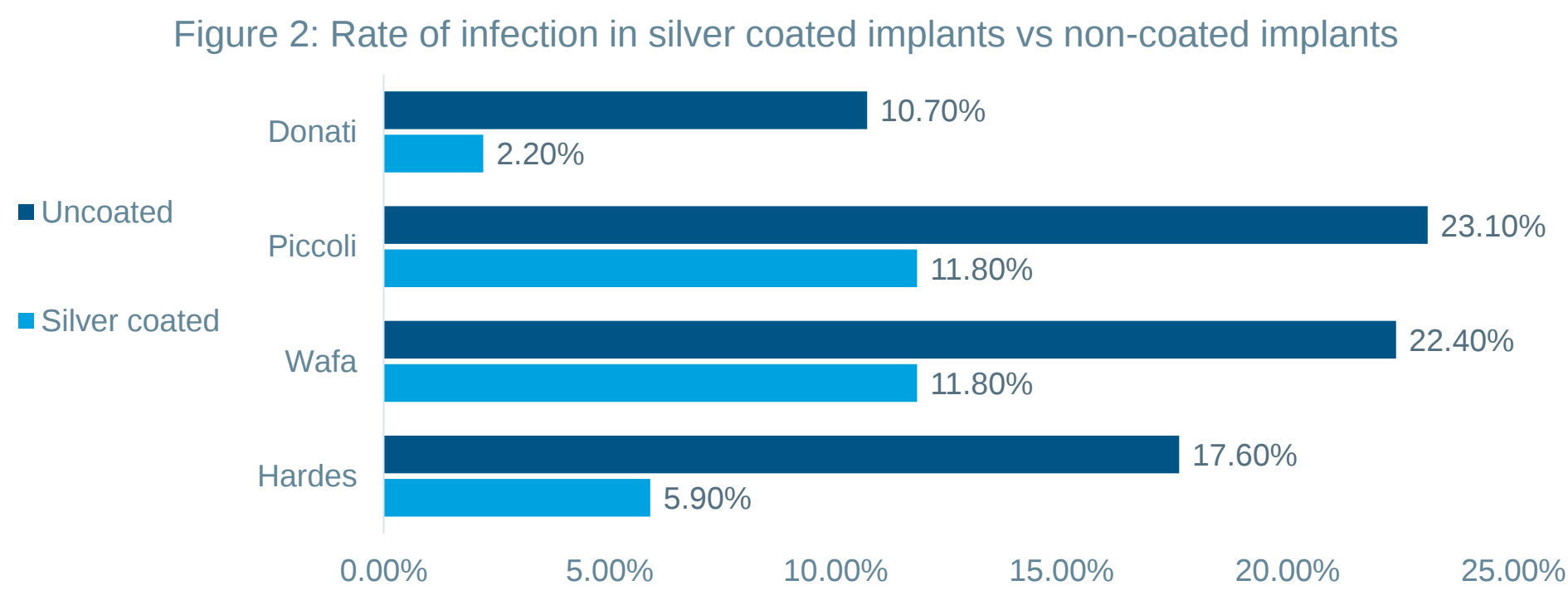
Data sources and search strategy- Relevant publications were searched in electronic databases: (1) EMBASE, (2) PubMed, and (3) Cochrane Library, limited for January 2011 to December 2021. Grey literature search was also conducted.
Inclusion and exclusion criteria- Standard PICOS (Population, Intervention, Comparator, Outcomes, and Study design) elements were used to define study characteristics as shown in Figure 1.
Screening process- Identified studies were screened by two independent reviewers, at two-stage screening selection process: first, based on the title/abstract, followed by full-text screening. The data were extracted from the included studies after comprehensive screening.
Quality assessment- The quality assessment of included studies was performed by Newcastle-Ottawa-Scale



Results

- A comprehensive review was conducted according to general recommendations of the Cochrane Handbook for Systematic Reviews of Interventions and 10 studies were included
- Seven studies reported impact of silver coated implants, while ceramic coated implants, iodine coated implants and calcium-based bone substitute coatings were reported by one study each
- Out of five studies reporting impact of silver coating 4 reported significantly reduced rate of infection in silver coated group as compared to non-coated group (Fig.2)
- One study assessed silver ion concentration in immediate surrounding of periprosthetic tissue, increased concentration of silver was reported (0.008ppm)
- Another study, a case series reported a 10% of infection rate which is lower than in other reported studies using non-silver-coated implants

- For other coatings there are only few reports available. For Iodine coated implant prevention and treatment of infections in large bone defects was reported with prevention of infection in 20 out of 21 patients. Calcium-Based, Antibiotic-Loaded Bone Substitute as an Implant Coating; reported ~95% success rate as 19/20 patients showed no recurrence of infection and no signs of radiographic loosening of the stem. However, implants with ceramic coating did not show any improvement.



Study_Year	Table 1: Impact of surface modification		
	Type of coating	Population	Outcomes
Wilding C. 2016 ²	Silver-Coated Arthrodesis Implant	Infected revision arthroplasty patients	The change in oxford knee score (OKS) pre and post arthrodesis was improved by 8.9 points (p=0.086)
Hardes J. 2010 ³	Silver-coated megaprotheses	Patients with bone sarcoma	The infection rate was substantially reduced from 17.6% (Non-coated) to 5.9% (coated). 38.5% of patients in the non-coated group ultimately had to undergo amputation when periprosthetic infection developed, these mutilating surgical procedures were not necessary in the coated group
Hussmann B. 2013 ⁴	silver-coated endoprosthesis	Revision surgery after trauma or infection prophylaxis in oncologic patients	Mean value of this silver ion concentration was 0.08 ppm In patients with silver ion concentration >0.08ppm no reinfection was detected
Wafa H. 2015 ⁵	Silver-treated endoprosthesis	patients underwent endoprosthesis replacement	At one year in patients who received a silver-treated implant reinfection rate was 11.8% (10/85) compared with 22.4% (19/85) in the control group (p = 0.033)
Schmolders J. 2016 ⁶	modular silver-coated megaprotheses	Patients undergoing tumor-related lower limb salvage surgery	Rate of infection in this case series is 10% which is lower than in other reported studies using non-silver-coated implants
Piccoli A. 2016 ⁷	Silver-coated prosthesis	Pathological limb fracture after primary or metastatic bone tumors	11.8% patients treated with silver-coated implants developed infection vs. 23.1% treated with uncoated No cases of early infection in the silver-coated prosthesis group, vs. 66.7% in control group
Donati F. 2015 ⁸	Silver-coated prostheses	Cases of bone tumors, primary or metastatic tumor implant reconstruction	Patients treated with silver-coated implants developed early infection in 2.2% of cases against the 10.7% of the patients treated with standard tumor prosthesis.
Shirai T. 2014 ⁹	Iodine-coated megaprotheses	Malignant bone tumor or pyogenic arthritis	Infection was prevented in 20 out of 21 patients. Only one patient had surgical site infection and was cured by IV antibiotics alone without removal of the implant
Logoluso N. 2016 ¹⁰	Calcium-based, antibiotic-loaded bone substitute	Cementless or hybrid two-stage revision surgery for PJI	19/20 (95%) patients showed no recurrence of infection and no signs of radiographic loosening of the stem.
Grimberg A. 2021 ¹¹	Ceramic Coating	primary TKAs in patients with primary osteoarthritis	No evidence of reduced risk for PJI due to ceramic-coated implants in cemented primary TKA was found
PJI: Periprosthetic Joint Infection; TKA: Total Knee Arthroplasty; OKS: Oxford Knee Score			

Conclusion

This SLR suggests that surface modified antimicrobial implants, especially silver and iodine coated, are effective in preventing and controlling PJI in patients undergoing knee arthroplasties along with treating re-infection cases with implant retention with less aggressive treatment
There is limited data on other types of coating, which include ceramic coating which showed no benefit in one study
These surface modified implants particularly silver coated can be most useful in complex surgeries where risk of re-infection is high also particularly useful in two-stage revisions for infection and in those patients with incidental positive cultures at the time of implantation of the prosthesis

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