Antimicrobial strategies and multidisciplinary care in prosthetic joint infections

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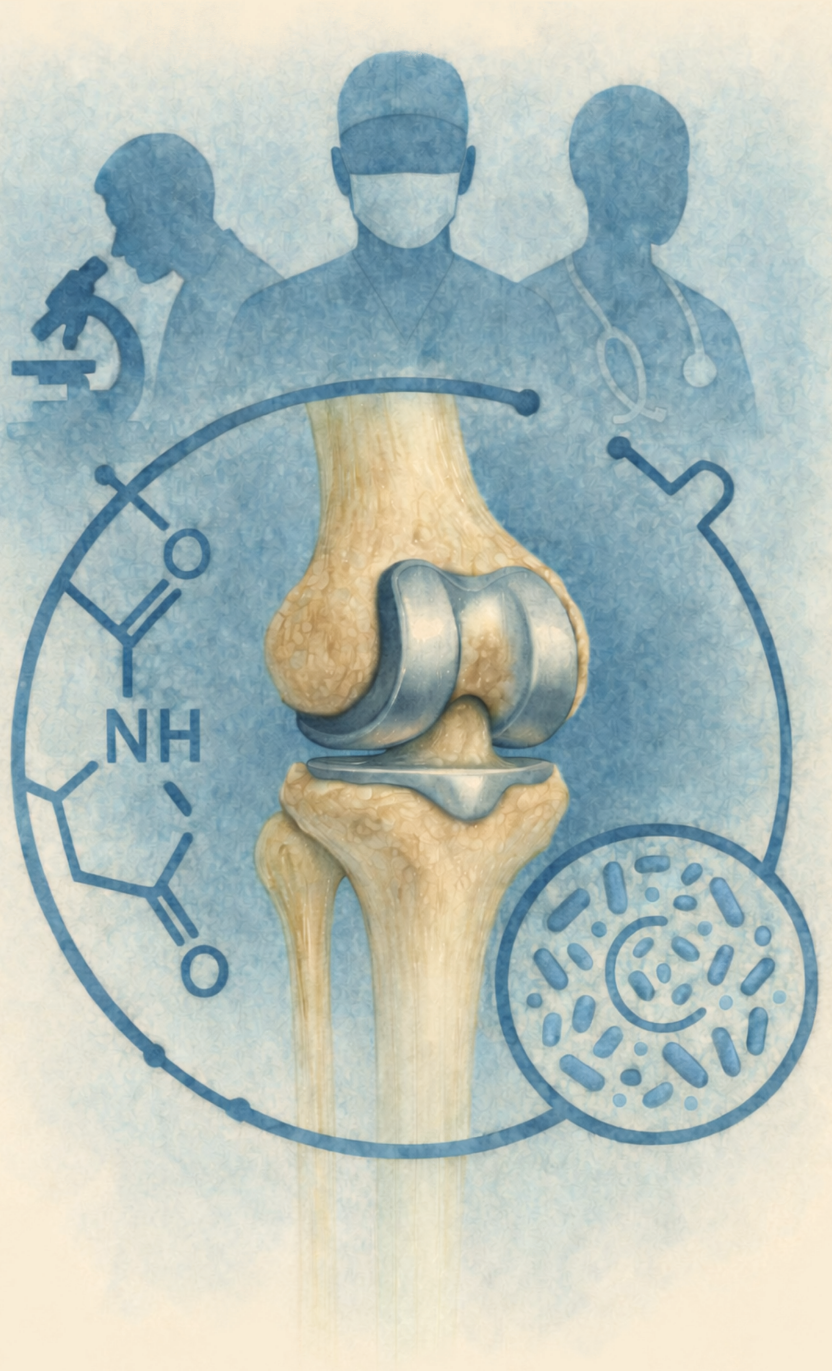
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Part I

Multidisciplinary care for bone and joint infections

Chapter 2

Implementation of multidisciplinary team decisions on the management of complex bone and joint infections: an observational study

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Abstract

Background: Multidisciplinary team (MDT) management of prosthetic joint infections (PJI) and other bone and joint infections (BJI) is increasingly put into practice. However, studies evaluating the performance of MDTs in this field are scarce. We aimed to assess our MDT for complex BJI by determining the implementation rate of team decisions, analyzing factors associated with non-implementation and evaluating the clinical outcome of patients in whom MDT decisions were not implemented.

Methods: An observational study was conducted on all patients with a PJI or other BJI of which the management was discussed during MDT meetings between 2015 and 2022 in a tertiary care academic hospital. Patient characteristics and MDT data were obtained from electronic patient records. The multidisciplinary team consisted of orthopaedic surgeons, trauma surgeons, infectious diseases specialists and clinical microbiologists. A decision was considered not implemented if the patient did not receive the management that was decided by the MDT. Factors possibly associated with non-implementation were statistically analyzed using logistic regression.

Results: The analysis included 1321 MDT decisions on 509 patients. The overall implementation rate of MDT decisions was 92.1%. Reasons for non-implementation were disagreement by the treating surgeon with the MDT regarding the optimal treatment (n=24, 23%), patient preference for a different treatment (n=19, 18%), new clinical information not yet available during the MDT meeting that made the physician change management (n= 17, 16%) or unknown (n=45, 43%). Trauma surgeons were more likely to not implement an MDT decision (odds ratio 2.4, p=0.01) The cure rate of patients who received a different surgical strategy than decided by the MDT was 33%. The cure rate was lower if a patient chose to deviate from the MDT decision (46%) than when the treating physician chose to deviate from the MDT decision (77%).

Conclusion: The implementation rate of decisions made by our complex BJI MDT was high. Furthermore, the current study suggests that non-implementation of MDT decisions on surgical management and non-implementation initiated by the patient lead to poor clinical outcomes. An analysis of MDT decision implementation is a useful tool to evaluate the impact of MDTs and further improve its quality.

Introduction

Prosthetic joint infection (PJI), fracture related infections (FRI) and spinal implant infection (SII) are severe complications after surgery. The surgical and antimicrobial treatment is complex and requires the combined expertise of various medical specialties. Osteomyelitis and septic arthritis of a native joint are also challenging infections to treat. A multidisciplinary team (MDT) approach is considered beneficial in the care for patients with these complex bone and joint infections (BJI). Implementation of an MDT for patients with a PJI or FRI is advocated by several national orthopaedic societies (1-3). The organization of such an approach demands time resources and a considerable financial investment (4). Physicians who participated in PJI MDT meetings experienced that communication and standardization of care improved after installment of an MDT. However, data on the evaluation of quality, effectiveness and impact of MDTs for complex BJI are scarce(5, 6). Observational studies on clinical outcomes of PJI and FRI after implementation of a dedicated MDT report conflicting data and randomized controlled trials have not been performed (7-14). To the best of our knowledge, studies focusing on effective decision making by BJI MDTs are absent. Analysis of the actual implementation of MDT decisions can be a more reliable measure of MDT effectiveness than assessing clinical outcomes only (15). Observational studies in other fields showed that 6-42% of MDT decisions and recommendations were discordant compared to the actual treatment received by patients (15-28). The aim of this study was to evaluate the MDT for complex bone, joint and arthroplasty infections in our hospital by analyzing the implementation of its decisions in clinical management. Furthermore, we analyzed the factors associated with non-implementation and assessed the clinical outcome of patients in whom MDT decisions were not implemented. A secondary objective was to assess the content and evolution of the team meetings throughout the study period.

Materials and methods

This study was conducted at a tertiary care academic hospital in the Netherlands which is specialized in treatment of bone tumours and is a regional referral hospital for PJI and other complex BJI. About 180 arthroplasties are performed on a yearly basis in our hospital of which approximately 30 are tumour endoprostheses. The departments of Infectious Diseases and Clinical Microbiology work in close collaboration with the departments of Orthopaedic and Trauma surgery in case of BJI.

Multidisciplinary Team Meeting

All patients with PJI and other complex BJI are discussed in a weekly MDT meeting, to determine (perioperative) management (e.g. diagnostic procedures, surgical treatment, antibiotic therapy including possible long term suppression, timing of discharge and follow-up). PJI, FRI and SII are discussed at least twice and other complex BJI at least once. Key participants of the team include selected staff members from orthopaedic surgery, trauma surgery, infectious diseases, and clinical microbiology, all with a dedicated interest in BJI. Every meeting is held on the same location and is attended by at least one key member of each medical specialty. The team is complemented by residents from these specialties. Every meeting lasts 30-45 minutes and is prepared, chaired and documented by two orthopaedic surgery residents. The physician running the ward where the patient is admitted or the physician who primarily evaluated the patient in outpatient setting is responsible for enlisting the patient for MDT discussion and selecting the date of the meeting in which the patient will be discussed. All MDT members have access to the electronic patient file system and are expected to prepare enlisted cases prior to the meeting. Only patients who are enlisted beforehand will be discussed. The conclusions and decisions of the MDT are documented in the electronic patient file directly following case discussion. In case of absence of the responsible physician at the meeting, the MDT aims to communicate its decision directly to the physician as well.

Patient population

All cases discussed at the MDT meetings between July 2015 and April 2022 were included. For the purpose of this study, one patient discussed in one meeting was defined as a single MDT record. Data from patients with a PJI were retrieved from a quality register, as described previously (29). For each record, patient demographics, treating medical specialty, diagnosis, microbiology results and therapeutic strategies together with details of the MDT meeting and its decision were extracted from the electronic patient file using CTcue text mining software (CTcue B.V., Amsterdam, The Netherlands) in combination with manual patient file review. Data were stored in a secured database. Records were excluded when the MDT decision was not documented or if follow-up of a referred patient from another hospital was not noted in the electronic patient file of our institution.

MDT characteristics and analysis of decision implementation

MDT decision implementation was specified per medical specialty, type of infection and management category (surgical, antibiotic treatment or diagnostic). A decision was considered not implemented if the patient did not receive the management that was decided on by the MDT. Reasons for non-implementation were divided in four

categories: i. disagreement of the treating physician with the MDT regarding the optimal treatment, ii. patient preference for a different treatment, iii. additional clinical information that became available after the MDT meeting that made the physician change management, iv. the reason was not recorded in the patient file.

Failure was defined as one of the following outcomes: the appearance or persistence of a fistula, unplanned surgical intervention or admission for intravenous antibiotics due to persistence or relapse of the infection, restart of antibiotic treatment in case of relapse after stopping suppressive antibiotic treatment, serious side effects of antibiotic treatment (need for cessation or switch, hospital admission, death) in cases where the patient received antibiotics despite the MDT decision to stop or not initiate, death related to the infection. Patients were considered cured after a follow-up of minimal one year without treatment failure.

The evolution of the MDT meetings was assessed by analyzing the number of discussed patients per meeting, the number of times an individual patient was discussed, the treating medical specialty, the distribution of type of infections and the MDT decision implementation rate over time.

Statistical analysis

Patient characteristics as well as documentation of the MDT meetings were summarized using descriptive statistics. A univariable logistic regression was performed and odds ratios calculated for the assessment of association of categorical variables with non-implementation. P-values ≤0.05 were considered significant. All statistical tests were performed 2-sided (SPSS Statistics for Windows was used (IBM SPSS Statistics for Windows, Version 25.0.0.2, Armonk, NY).

Results

Of 1342 MDT records, 1321 MDT decisions from 329 MDT meetings on 509 individual patients were included. Twenty-one records (1.6%) were excluded due to absence of documentation of the MDT decision or in case there was no follow-up of referred patients from another hospital in the electronic patient file. Baseline clinical characteristics are summarized in Table 1. Forty-four percent of patients had a PJI, 18% (vertebral) osteomyelitis, 16% native joint septic arthritis, 12% FRI, 6% skin and soft tissue infection (SSTI) and 3% SII. A debridement in the context of PJI, SSTI, septic arthritis or osteomyelitis was the most frequently performed surgical treatment (55%). A conservative treatment was chosen in 27% of the patients. The number of

MDT discussions per patient ranged between one and 18; 299 patients (59%) were discussed more than once and 27 patients (5.3%) at seven or more separate meetings. The attendance rate was highest for orthopaedic surgeons, infectious diseases specialists and clinical microbiologists (100%, 100% and 80%, respectively).

Table 1. Characteristics of 509 patients discussed at bone and joint infection multidisciplinary team meetings

Female/Male	214/295
Age, years (IQR)	61 (44-72)
Type of infection (n,%)	
Prosthetic joint infection	219 (44)
Tumour endoprosthesis	89 (18)
Fracture related infection	59 (12)
Spinal implant infection	16 (3)
(Vertebral) osteomyelitis	93 (19)
Septic arthritis native joint	82(16)
Skin and soft tissue infection	31 (6)
Site of infection (n,%)	
Hip	112 (22)
Knee	131 (26)
Other joints	72 (14)
Bone and soft tissue	194 (38)
Treatment strategy(n,%)[a]	
Debridement, Antibiotics, Implant Retention	157 (28)
Debridement of skin and soft tissue infection, osteomyelitis or septic arthritis	153 (27)
One and two stage revisions	47 (8)
Girdlestone resection arthroplasty and amputation	24 (4)
Removal of osteosynthesis material	35 (6)
Non-surgical[b]	153 (27)
Suppressive antibiotic therapy	89 (17)
Number of multidisciplinary team discussions per patient	
1	210 (41)
2-3	179 (35)
4-7	93 (18)
>7	27 (5)

[a]Some patients underwent multiple surgical strategies. A two stage revision counted as one surgery.
[b]Antibiotic therapy only or wait and see policy
Abbreviations: IQR, interquartile range

Implementation and non-implementation of MDT decisions

Out of 1321 MDT decisions, 1216 (92.1%) were implemented and 105 (7.9%) were not implemented. The non-implementation rate of MDT decisions was mostly related to surgical, antibiotic or diagnostic management (n=89, 84.8%). Sixteen (15.2%) decisions concerned a MDT request for follow-up at a future MDT meeting which, for unknown reasons, was not performed.

Non-implementation rates were different between orthopaedic surgery (7.4%), trauma surgery (17.3%) and non-surgical medical specialties (7.5%) (p=0.01). Type of infection, gender and age were not associated with non-implementation (Table 2).

Table 2. Univariable analysis of factors potentially associated with non-implementation of multidisciplinary team decisions

Variables	MDT decisions (n)	Non-implemented decisions (n, %)	OR (95% CI)	p-value[a]
Patient				
Age >65	583	48 (8)	1.0 (0.73 - 1.64)	0.66
Male	742	59 (8)	1.0 (0.67 - 1.50)	0.99
Infection				
Chronic (vs acute)	614	53 (9)	1.2 (0.77 - 1.88)	0.42
Implant related[b] (vs non-implant related)	877	76 (9)	1.36 (0.87 - 2.12)	0.18
Treating specialty				
Orthopaedic surgery	1179	87 (7)	0.59 (0.34 - 1.02)	0.06
Trauma surgery	75	13 (17)	2.4 (1.25 - 4.62)	0.01
Medical[c]	67	5 (8)	0.93 (0.37 - 2.37)	0.88

[a]P-value calculated by chi-squared test

[b]Prosthetic joint infection, fracture related infection, spinal implant infection

[c]Infectious diseases, rheumatology, pediatrics

Abbreviations: OR, odds ratio; CI, confidence interval

The reasons for not implementing MDT decisions are depicted in Figure 1. Non-implementation was mostly due to disagreement of the treating surgeon with the MDT regarding the optimal treatment (n=24, 23%). In 45 cases (43%), the reason could not be deducted from the electronic patient files.

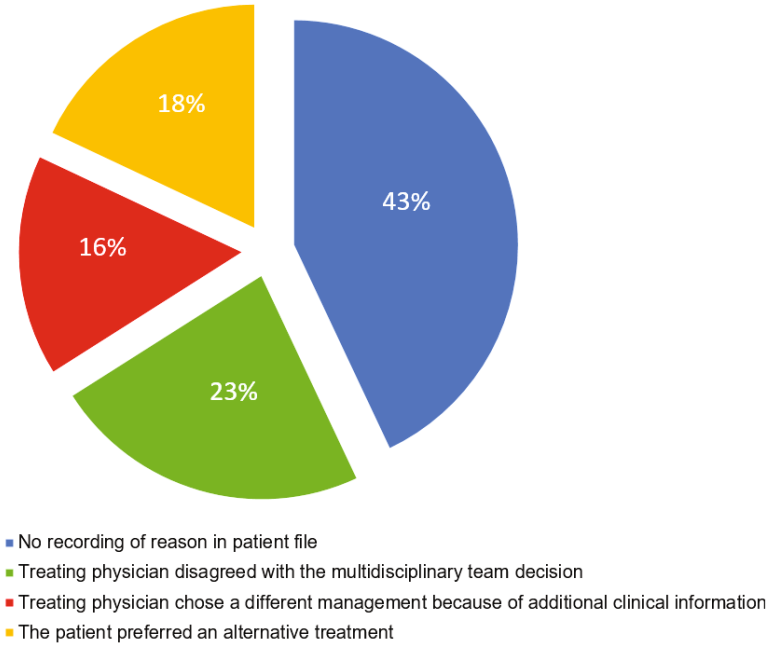

Figure 1. *Reasons of non-implementation of multidisciplinary team decisions for bone and joint infections*

The actual management received by patients and clinical outcome of all patients with non-implemented decisions (n=105) are shown in Table 3 (for a more detailed overview of the deviating strategies, see Supplementary table 1).

Eleven patients in this group (10%) were lost to follow-up and in eight patients (8%) a non-infectious diagnosis was made. Of the remaining 86 patients with a non-implemented decision, 59 (69%) were cured and in 27 patients (31%) the treatment failed. Non-implemented decisions regarding surgical management were associated with a lower cure rate (33%) than non-implemented decisions regarding antibiotic or diagnostic management (cure rates 71% and 83%, respectively). The cure rate was lower in the cases where the patient chose to deviate from the MDT decision (46%) than when the treating physician chose to deviate from the MDT decision (77%).

Table 3. Actual management and clinical outcome of all 105 non-implemented multidisciplinary team decisions

Multidisciplinary team decision	n (%)	Actual management	n (%)	Cure rate[a]
Perform surgery[b]	33 (32)	Non-surgical strategy	27 (26)	33%
		Other surgical strategy	6 (6	
Start/continue antibiotic therapy	32 (31)	No antibiotic therapy	26 (25)	66%
		Other antibiotic therapy	6 (6)	
Stop antibiotic therapy	9 (9)	Antibiotic therapy continued	9 (9)	88%
Perform diagnostic procedure	15 (14)	Imaging not performed	9 (9)	83%[c]
		Punction/biopsy not performed	6 (6)	
Follow-up at future meeting to determine further treatment	16 (15)	No follow-up at future meeting	16 (15)	100%[c]

[a]Cure was defined as the absence of failure with a minimal follow-up of one year. Failure was defined as one of the following outcomes: a fistula, hospital admission due to relapse of the infection, restart of antibiotic treatment after stopping suppressive antibiotic treatment, death related to the infection and side effects of antibiotic treatment leading to discontinuation, hospital admission or death in cases where the patient received antibiotics despite the multidisciplinary team decision to stop.

[b]Debridement, Antibiotics, Implant Retention (DAIR); one stage revision; two stage revision; girdle stone resection arthroplasty; amputation; debridement of osteomyelitis

[c]Excluding eight cases that did not have an infection after final diagnostic work-up

Evolution of MDT meetings

The evolution of the MDT meetings over time is summarized in Table 4. The non-implementation rate of MDT decisions was constant over the seven-year period (range 5.9 – 9.8%, p = 0.78). The mean number of patients discussed by the MDT increased from a of 2.7 to 5.5 per meeting. The mean number of MDT discussions ranged between 2.3 and 2.9 per patient. The majority (90-95%) of patients discussed were treated by orthopaedic surgeons. During the first four years, the percentage of patients treated by trauma surgeons increased from 1% to 11%. During the entire study period the percentage of non-PJI infections increased from 26% to 52%.

Table 4. Characteristics of the multidisciplinary team meeting and the team decision implementation rate

Overall	Overall	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6[a]	Year 7[b]	p-value[c]
General characteristics	*(n)*								
Decisions	1321	121	142	218	192	239	184	225	
MDT meetings	329	45	49	49	50	49	46	41	
New patients	509	51	59	84	73	83	75	84	
Patients discussed per meeting (average)	4.0	2.7	2.9	4.4	3.8	4.9	4.0	5.5	
Treating specialism	*(n,%)*								
Orthopaedic surgery	1179 (89)	116 (96)	132 (93)	202 (93)	173 (90)	196 (82)	164 (89)	196 (87)	
Trauma surgery	75 (6)	1 (1)	1 (1)	3 (1)	6 (3)	26 (11)	13 (7)	25 (11)	
Medical[d]	67 (5)	4 (3)	9 (6)	13 (6)	13 (7)	17 (7)	7 (4)	4 (2)	
Type of infection discussed	*(n,%)*								
Prosthetic joint infection	365 (27)	57 (46)	37 (25)	54 (25)	51 (26)	60 (25)	56 (30)	53 (24)	
Tumour endoprosthesis infection	314 (24)	34 (28)	40 (28)	70 (32)	41 (21)	38 (16)	39 (21)	53 (24)	
Fracture related infection	159 (12)	5 (4)	11 (8)	25 (12)	28 (15)	40 (17)	24 (13)	27 (12)	
Spinal implant infection	35 (3)	4 (3)	0	12 (6)	6 (3)	4 (2)	2 (1)	8 (3)	
(Vertebral) osteomyelitis	237 (18)	15 (12)	32 (21)	25 (12)	36 (19)	42 (17)	44 23)	50 (23)	
Septic arthritis native joint	143 (11)	5 (4)	17 (12)	25 (12)	22 (12)	45 (19)	15 (8)	17 (7)	
Skin and soft tissue infection	51 (4)	1 (1)	7 (5)	5 (2)	9 (5)	10 (4)	4 (2)	17 (7)	
MDT decision implementation	*(%)*								
All specialties	92	92	91	92	93	94	91	90	0.78
Orthopaedic surgery	93	92	90	92	93	95	92	92	0.79
Trauma surgery	83	100	100	67	100	92	85	71	0.36
Medical[d]	93	75	100	100	92	88	100	75	0.38

Table 4. Characteristics of the multidisciplinary team meeting and the team decision implementation rate *(Continued)*

Overall	Year 1		Year 2	Year 3	Year 4	Year 5	Year 6[a]	Year 7[b]	p-value[c]
Type of infection									
Prosthetic joint infection	93	91	92	91	94	93	93	94	
Tumour endoprosthesis infection	93	85	93	93	100	97	87	94	
Fracture related infection	89	100	100	92	96	93	88	69	
Spinal implant infection	83	100	-	75	50	100	100	100	
(Vertebral) osteomyelitis	91	100	87	96	83	93	93	92	
Septic arthritis native joint	94	100	82	100	100	96	100	81	
Skin and soft tissue infection	98	100	100	80	100	100	100	100	

[a]During Coronavirus disease 2019 (COVID-19) pandemic

[b]Contains 10 months of data, June 2021 – April 2022

[c]For trend over time

[d]Infectious diseases, rheumatology, pediatrics

Abbreviation: MDT, multidisciplinary team

Discussion

Multidisciplinary team decision implementation

The current study focused on MDT decision implementation because such an analysis is reported to be a good proxy for effective decision making (15). The high implementation rate of 92.1% confirmed the ability to reach consensus during the MDT. High implementation rates can only be reached when all relevant information is available during the MDT meeting and when the preferences of the patient and treating physician are taken into account. Furthermore, analysis of adherence to MDT decisions allows for a better comparison between BJI MDTs in other clinics than analysis of clinical outcomes because outcome is strongly influenced by the clinical setting (e.g. primary versus tertiary hospital) or the type of infection (e.g. implant-related versus other BJI). The MDT decision implementation rate of our cohort is comparable to other MDT implementation studies in oncology, cardiology, mental health and surgery (4, 15-28, 31-33).

Non-implementation of MDT decisions

The analysis of non-implementation provided us with important insights on the consequences of deviation from MDT decisions. In the group of patients in which the MDT decision was not adhered to, deviating from surgical management resulted in lower cure rates. This could mean that deviating from MDT decisions leads to a worse outcome. However, it is also possible that non-implementation occurs more often in highly complex cases with an a-priori higher risk of failure. Nonetheless, it indicates that an explicit reason should be present to justify an alternative strategy. Of 41 cases, in which the physician clearly documented the reason for a different strategy, new clinical information after the MDT meeting indeed justified the deviation from the MDT decision in 17 cases. This illustrates that 100% MDT decision implementation is not a goal in itself. In a minority of cases, patients themselves opted for a different treatment, probably because their preferences were unknown to the MDT. Patient involvement in the management and evaluation of their infection is important. This may be realized by inviting patients, case managers or dedicated PJI nurses to MDT meetings to bring in more patient centered issues (34). In cancer MDT studies, patients were eager to be more involved, but not all MDT members considered this as beneficial (35, 36). In most cases, the reason to deviate from the MDT decision was not recorded in the patient file. This may be explained by incomplete or improper registration of MDT considerations or unawareness of the physician that the MDT discussed his patient. Unfortunately, we were not able to determine the attendance of individual physicians to the MDT to relate this to non-implementation. Another explanation for the absence of documented considerations in the patient file could be

that the physician did not record this to prevent medicolegal problems of deliberately not implementing MDT decisions (15).

In our cohort, non-implementation of MDT decisions occurred more in patients treated by trauma surgeons. The main reason for this was disagreement by the surgeon with the MDT decision on the treatment strategy. This may be related to the absence of the treating surgeon during MDT meetings. Further, orthopaedic surgeons and infectious diseases specialists were more used to implement MDT decisions because they discussed more patients over the years (Table 2). Cases with a deviation from the MDT recommendation on surgical management had a high failure rate. This points out the need for proper registration of the MDT considerations to inform the physician as much as possible when he considers not to adhere to the MDT decision. The finding of a high failure rate when patients chose a different treatment than the MDT recommended, stresses the importance of informing the patient on the expected outcome when a recommended treatment is not given.

Evolution of the MDT

Over the years, the MDT has expanded its scope from only PJI to a wide range of complex bone and joint infections. This reflects the advantages of our MDT as seen by other specialties that treat patients with complex BJI. Collaboration harmonizes diagnostic and treatment strategies for different BJI, increases the expertise of the participating specialists group and is ultimately beneficial for patients (8-10, 14). The rising number of patients to be discussed, imposes an increased demand for preparation time on MDT participants. In the context of limited time resources prevalent in many healthcare systems, this may negatively influence the quality of decision-making processes. Furthermore, this increase of patients potentially diminishes the available time allocated for in-depth patient discussions. To keep MDT meetings as structured and efficient as possible, we suggest the following measures: i. Development of a clear protocol stating what information is needed at the meeting, how to discuss patients and in which order (facilitated by a strict format in the electron patient file), ii. Collection of complete clinical information when enlisting the patient including the patient's preferences, iii. Thorough case preparation by all team members, iv. Appointment of a chair who adheres to the protocol and strictly keeps track of time (15, 30).

Current and future perspectives

We conducted an appraisal of the available literature to review the indicators that are currently used for assessing the quality and impact of MDTs for BJI. Eight observational studies analyzed clinical parameters before and after installment of an MDT (table 5). The majority reported no statistically significant effect on cure, but this could be due to the small number of included patients (7-14). Inherent to their observational design, these studies are subjected to bias making the true effect of the MDT on outcomes difficult to determine.

Two studies on PJI MDT evaluation focused on MDT member experiences and team dynamics using qualitative methods. After interviewing team members, Awad et al. reported that physicians who participated in MDT meetings experienced that communication and standardization of care improved after installment of an MDT (5). Analysis of video recordings led to the conclusion that MDT meetings increased inter-specialty understanding and communication and improved recognition and acknowledgement of treatment failure (6). To conclude, MDTs for BJI are increasingly being implemented worldwide and are believed to be essential for optimal care, but supporting data are scarce and inconclusive. A randomized controlled trial to answer this question seems unethical due to the widely shared consensus that MDTs improve care for patients (1-3, 10-12, 37). To establish if MDTs are actually beneficial in BJI care we suggest using a broad range of indicators to evaluate its impact. Examples of such indicators are MDT decision implementation, guideline implementation, attendance of team members, documentation of decisions, patient involvement and cost-effectiveness. This will not only provide an insight in local MDT functioning but could also generate suggestions for improvement of MDTs in other clinics where patients with complex BJI are treated.

Strengths and limitations

Major strengths of this study are the large number of included patients and MDT decisions, its longitudinal design and the completeness of the data. This enabled us to comprehensively assess non-implementation considerations after the MDT meetings. Unfortunately, we could not retrieve the time spent per patient discussion, which would provide a more complete insight in the time burden. Further, we did not collect the clinical outcomes of patients who had decisions implemented as this was not the focus of the study. Due to the observational character of the study, we could not evaluate all aspects of the MDT discussions and consultation of patients, for which tape recordings or transcripts of the MDT meetings would be valuable.

Table 5. Cohort studies comparing clinical parameters prior to and after implementation of a multidisciplinary team for complex bone and (prosthetic) joint infections

Reference	Number of cases	Type of infections	Surgical management	Outcomes	Prior to vs after implementation of a multidisciplinary team
Sires et al, 2023	71	PJI	DAIR, 1SR, 2SR, RA	Cure after 2 years	85% vs 86% (p=0.95)
				Length of stay (days)	43.4 vs 42.8 (p=0.94)
				Total number of AB	3.4 vs 2.8 (p=0.19)
				Number of surgeries	1.93 vs 2.25 (p=0.04)
				Percentage DAIR as primary surgery	11.1% vs 34.1%
Rupp et al, 2023	117	FRI	DAIR, 1SR, 2SR	Cure	68% vs 76% (p=0.18)
				Length of stay (days)	52.2 vs 42.3 (p=0.21)
				Bone consolidation	85% vs 90% (p=0.44)
				Recurrence rate within 1 year	27% vs 21% (p=0.24)
Walter et al, 2022	49	PJI	Not given	Success rate	17% vs 65% (p=0.16)
				Recurrence rate within 1 year	41% vs 20% (p=0.12)
				Revision rate	2.5 vs 1.7 (p=0.04)
Vourinen et al, 2021	154	PJI	DAIR, 1SR, 2SR	Cure after 2 years	74% vs 85% (p=0.31)
				Cure of DAIR after 2 years	56% vs 85% (p=0.08)
				Length of stay (days)	49 vs 17 (p=0.00)
				Percentage DAIR as primary surgery	42% vs 90% (p=0.00)
Biddle et al, 2021	58	PJI	DAIR, 1SR, 2SR	Cure after 2 years	59% vs 97% (p=0.00)
				Length of stay (days)	40 vs 47 (p=0.74)
				Time to microbiology advice (days)	8.5 vs 3.1 (p=0.00)
Ntalos et al, 2019	46	PJI	DAIR, 1SR, 2SR	Length of stay (days)	62 vs 29 (p<0.05)
				Number of surgeries (mean)	5.1 vs 1.8 (p<0.05)
				Number of AB (mean)	4.2 vs 2.8 (p<0.05)

Table 5. Cohort studies comparing clinical parameters prior to and after implementation of a multidisciplinary team for complex bone and (prosthetic) joint infections *(Continued)*

Reference	Number of cases	Type of infections	Surgical management	Outcomes	Prior to vs after implementation of a multidisciplinary team
Karczewski et al, 2019	18	PJI	2SR	Recurrence after 2 years	90% vs 97% (p=0.04)
				New infections after 2 years	92 % vs 92% (p=0.95)
				Mean time interval between 2 stages of 2SR (days)	81 vs 67 (p<0.01)
				Length of stay (days)	29 vs 30 (p=0.63)
Bauer et al, 2012	60	BJI including PJI and FRI	Not given	Cure at 6 months	47% vs 57% (p=0.45)
				AB adaptation to microbiology	47% vs 96% (p<0.00)
				Optimal dosing of AB	72% vs 89% (p=0.11)
				Length of stay (days)	19.8 vs 23.1 (p=0.35)

Abbreviations: PJI, prosthetic joint infection; FR, fracture related infection; BJI, bone and joint infection; DAIR, Debridement, Antibiotics, Implant Retention; 1S,: one stage revision; 2SR, two stage revision; RA, resection arthroplasty; AB; antibiotics

Conclusion

In this study, the high implementation rate of MDT decisions on the management of BJI indicated an effective multidisciplinary team. Not implementing MDT decisions on surgical management was associated with a poor clinical outcome. Non-implementation of MDT decisions was mostly the choice of the treating physician and was not always justified. The analysis of non-implementation provided us with several measures to further improve our MDT quality. Analysis of MDT decision implementation is a useful tool for clinicians who wish to evaluate and improve their MDT. Evaluation of different aspects and indicators of MDT performance, other than clinical parameters, will improve the knowledge about providing optimal multidisciplinary care for patients with complex BJI.

References

1. *Govaert GAM, Termaat MF, Glaudemans A, Geurts JAP, de Jong T, de Jong VM, et al. [Diagnosis and treatment of fracture-related infections]. Ned Tijdschr Geneeskd. 2019;163.*
2. *Kalson NS, Mathews JA, Alvand A, Morgan-Jones R, Jenkins N, Phillips JRA, et al. Investigation and management of prosthetic joint infection in knee replacement: A BASK Surgical Practice Guideline. Knee. 2020;27(6):1857-65.*
3. *Walter N, Rupp M, Baertl S, Alt V. The role of multidisciplinary teams in musculoskeletal infection. Bone Joint Res. 2022;11(1):6-7.*
4. *De Ieso PB, Coward JI, Letsa I, Schick U, Nandhabalan M, Frentzas S, et al. A study of the decision outcomes and financial costs of multidisciplinary team meetings (MDMs) in oncology. Br J Cancer. 2013;109(9):2295-300.*
5. *Awad F, Searle D, Walmsley K, Dyar N, Auckland C, Bethune R, et al. The Exeter Knee Infection Multi Disciplinary Team approach to managing prosthetic knee infections: A qualitative analysis. J Orthop. 2020;18:86-90.*
6. *Broom J, Broom A, Kenny K, Konecny P, Post JJ. Multidisciplinary team meetings in prosthetic joint infection management: A qualitative study. Infect Dis Health. 2023.*
7. *Bauer S, Bouldouyre MA, Oufella A, Palmari P, Bakir R, Fabreguettes A, et al. Impact of a multidisciplinary staff meeting on the quality of antibiotherapy prescription for bone and joint infections in orthopedic surgery. Med Mal Infect. 2012;42(12):603-7.*
8. *Biddle M, Kennedy JW, Wright PM, Ritchie ND, Meek RMD, Rooney BP. Improving outcomes in acute and chronic periprosthetic hip and knee joint infection with a multidisciplinary approach. Bone Jt Open. 2021;2(7):509-14.*
9. *Karczewski D, Winkler T, Renz N, Trampuz A, Lieb E, Perka C, et al. A standardized interdisciplinary algorithm for the treatment of prosthetic joint infections. The Bone & Joint Journal. 2019;101-B(2):132-9.*
10. *Ntalos D, Berger-Groch J, Rohde H, Grossterlinden LG, Both A, Luebke A, et al. Implementation of a multidisciplinary infections conference affects the treatment plan in prosthetic joint infections of the hip: a retrospective study. Arch Orthop Trauma Surg. 2019;139(4):467-73.*
11. *Rupp M, Walter N, Popp D, Hitzenbichler F, Heyd R, Geis S, et al. Multidisciplinary Treatment of Fracture-Related Infection Has a Positive Impact on Clinical Outcome-A Retrospective Case Control Study at a Tertiary Referral Center. Antibiotics (Basel). 2023;12(2).*
12. *Sires JD, Pham K, Wilson CJ. The Impact of a Dedicated Multidisciplinary Team Approach for Prosthetic Joint Infections of the Lower Limb. Indian J Orthop. 2023;57(5):696-702.*
13. *Vuorinen M, Makinen T, Rantasalo M, Huotari K. Effect of a multidisciplinary team on the treatment of hip and knee prosthetic joint infections: a single-centre study of 154 infections. Infect Dis (Lond). 2021;53(9):700-6.*
14. *Walter N, Rupp M, Baertl S, Ziarko TP, Hitzenbichler F, Geis S, et al. Periprosthetic joint infection : patients benefit from a multidisciplinary team approach. Bone Joint Res. 2022;11(1):8-9.*
15. *Raine R, Wallace I, Nic a' Bhaird C, Xanthopoulou P, Lanceley A, Clarke A, et al. Improving the effectiveness of multidisciplinary team meetings for patients with chronic diseases: a prospective observational study. Health Services and Delivery Research. Southampton (UK)2014.*
16. *English R, Metcalfe C, Day J, Rayter Z, Blazeby JM, breast cancer multi-disciplinary t. A prospective analysis of implementation of multi-disciplinary team decisions in breast cancer. Breast J. 2012;18(5):459-63.*

17. *Gashin L, Tapper E, Babalola A, Lai KC, Miksad R, Malik R, et al. Determinants and outcomes of adherence to recommendations from a multidisciplinary tumour conference for hepatocellular carcinoma. HPB (Oxford). 2014;16(11):1009-15.*

18. *Ghazal Asswad R, Alvi S, Davies K, Jones TM, Hamilton DW, Brammer C, et al. The role of multidisciplinary decision making in oropharyngeal cancer: do we follow guidelines and are treatment decisions being implemented? Eur Arch Otorhinolaryngol. 2020;277(3):947-52.*

19. *Prouse G, Robaldo A, van den Berg JC, Ettorre L, Mongelli F, Giovannacci L. Impact of Multidisciplinary Team Meetings on Decision Making in Vascular Surgery: A Prospective Observational Study. Eur J Vasc Endovasc Surg. 2023.*

20. *Rajan S, Foreman J, Wallis MG, Caldas C, Britton P. Multidisciplinary decisions in breast cancer: does the patient receive what the team has recommended? Br J Cancer. 2013;108(12):2442-7.*

21. *Rangabashyam MS, Lee SY, Tan SY, Mueller S, Sultana R, Ho J, et al. Adherence of head and neck squamous cell carcinoma patients to tumor board recommendations. Cancer Med. 2020;9(14):5124-33.*

22. *Samarasinghe A, Chan A, Hastrich D, Martin R, Gan A, Abdulaziz F, et al. Compliance with multidisciplinary team meeting management recommendations. Asia Pac J Clin Oncol. 2019;15(6):337-42.*

23. *Soon JJY, Zhao Y, Shannon NB, Tan JTH. Adherence to Multidisciplinary Tumor Board Recommendations in Patients With Curable Esophageal and Gastric Cancers. J Gastrointest Cancer. 2022.*

24. *Ung KA, Campbell BA, Duplan D, Ball D, David S. Impact of the lung oncology multidisciplinary team meetings on the management of patients with cancer. Asia Pac J Clin Oncol. 2016;12(2):e298-304.*

25. *Yang X, Huang J, Zhu X, Shen K, Zhu J, Chen X. Compliance with multidisciplinary team recommendations and disease outcomes in early breast cancer patients: An analysis of 4501 consecutive patients. Breast. 2020;52:135-45.*

26. *Hollunder S, Herrlinger U, Zipfel M, Schmolders J, Janzen V, Thiesler T, et al. Cross-sectional increase of adherence to multidisciplinary tumor board decisions. BMC Cancer. 2018;18(1):936.*

27. *Kotsougiani-Fischer D, Fischer S, Warszawski J, Gruetzner PA, Reiter G, Hirche C, et al. Multidisciplinary team meetings for patients with complex extremity defects: a retrospective analysis of treatment recommendations and prognostic factors for non-implementation. BMC Surg. 2021;21(1):168.*

28. *Rimmele DL, Larena-Avellaneda A, Alegiani AC, Rosenkranz M, Schmidt NO, Regelsberger J, et al. Real-world experience of treatment decision-making in carotid stenosis in a neurovascular board. Neurology. 2017;89(4):399-407.*

29. *Scheper H, van der Wal RJP, Mahdad R, Keizer S, Delfos NM, van der Lugt JCT, et al. Effectiveness of Different Antimicrobial Strategies for Staphylococcal Prosthetic Joint Infection: Results From a Large Prospective Registry-Based Cohort Study. Open Forum Infect Dis. 2022;9(10):ofac474.*

30. *Soukup T, Lamb BW, Arora S, Darzi A, Sevdalis N, Green JS. Successful strategies in implementing a multidisciplinary team working in the care of patients with cancer: an overview and synthesis of the available literature. J Multidiscip Healthc. 2018;11:49-61.*

31. *Ameratunga M, Miller D, Ng W, Wada M, Gonzalvo A, Cher L, et al. A single-institution prospective evaluation of a neuro-oncology multidisciplinary team meeting. J Clin Neurosci. 2018;56:127-30.*

32. *Brunner M, Gore SM, Read RL, Alexander A, Mehta A, Elliot M, et al. Head and neck multidisciplinary team meetings: Effect on patient management. Head Neck. 2015;37(7):1046-50.*

33. *Lutterbach J, Pagenstecher A, Spreer J, Hetzel A, Velthoven V, Nikkhah G, et al. The brain tumor board: lessons to be learned from an interdisciplinary conference. Onkologie. 2005;28(1):22-6.*

34. *Lamb BW, Brown KF, Nagpal K, Vincent C, Green JS, Sevdalis N. Quality of care management decisions by multidisciplinary cancer teams: a systematic review. Ann Surg Oncol. 2011;18(8):2116-25.*

35. *Butow P, Harrison JD, Choy ET, Young JM, Spillane A, Evans A. Health professional and consumer views on involving breast cancer patients in the multidisciplinary discussion of their disease and treatment plan. Cancer. 2007;110(9):1937-44.*

36. *Choy ET, Chiu A, Butow P, Young J, Spillane A. A pilot study to evaluate the impact of involving breast cancer patients in the multidisciplinary discussion of their disease and treatment plan. Breast. 2007;16(2):178-89.*

37. *Carlson VR, Dekeyser GJ, Certain L, Pupaibool J, Gililland JM, Anderson LA. Clinical Experience With a Coordinated Multidisciplinary Approach to Treating Prosthetic Joint Infection. Arthroplast Today. 2020;6(3):360-2.*

Supplement

Supplementary table 1. Details of the 74 non-implemented multidisciplinary team decisions and actual management regarding surgical strategy and antibiotic treatment

Treatment decision	actual management	cure/failure/lost to follow-up
Surgical strategy		
DAIR, n=7	SAT, n=2	3/4
	AB, n=4	
	No surgery, no AB/SAT, n=1	
One or two stage revision, n=16	DAIR, n=1	3/8/5
	1SR instead of 2SR, n=2	
	Amputation, n=1	
	SAT, n=3	
	AB, n=2	
	No surgery, no AB/SAT n=7	
Remove osteosynthesis material, n=5	Debridement, n=2	2/3
	SAT, n=1	
	AB, n=1	
	No surgery, no AB/SAT n=1	
Amputation, n=2	SAT, n=1	0/2
	AB, n=1	
Debridement of osteomyelitis,	AB, n=1	2/0
n=2	No surgery, no AB/SAT, n=1	
Arthrodesis, n=1	No surgery, no AB/SAT, n=1	1/0
Antibiotic treatment		
SAT, n=24	Not initiated, n=16	16/4/4
	Stopped, n=6	
	Metronidazole instead of fluconazole, n=1	
	Cotrimoxazole instead of ciprofloxacin supp n=1	
AB, n=8	Not initiated, n=4	5/2/1
	Flucloxacillin iv instead of oral, n=2	
	Flucloxacillin instead of vancomycin, n=1	
	Clindamycin instead of flucloxacillin, n=1	
Do not start or stop antibiotic therapy, n=9	SAT, n=5	8/1
	AB, n=4	

[a]sulfamethoxazole/trimethoprim

Abbreviations: DAIR, debridement, antibiotics, implant retention; AB, therapeutic antibiotic therapy; SAT, suppressive antibiotic therapy