



Determinants of treatment plan implementation in multidisciplinary team meetings for patients with chronic diseases: a mixed-methods study

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ABSTRACT

Objective Multidisciplinary team (MDT) meetings are assumed to produce better decisions and are extensively used to manage chronic disease in the National Health Service (NHS). However, evidence for their effectiveness is mixed. Our objective was to investigate determinants of MDT effectiveness by examining factors influencing the implementation of MDT treatment plans. This is a proxy measure of effectiveness, because it lies on the pathway to improvements in health, and reflects team decision making which has taken account of clinical and non-clinical information. Additionally, this measure can be compared across MDTs for different conditions.

Methods We undertook a prospective mixed-methods study of 12 MDTs in London and North Thames. Data were collected by observation of 370 MDT meetings, interviews with 53 MDT members, and from 2654 patient medical records. We examined the influence of patient-related factors (disease, age, sex, deprivation, whether their preferences and other clinical/health behaviours were mentioned) and MDT features (as measured using the 'Team Climate Inventory' and skill mix) on the implementation of MDT treatment plans.

Results The adjusted odds (or likelihood) of implementation was reduced by 25% for each additional professional group represented at the MDT meeting. Implementation was more likely in MDTs with clear goals and processes and a good 'Team Climate' (adjusted OR 1.96; 95% CI 1.15 to 3.31 for a unit increase in Team Climate Inventory (TCI) score). Implementation varied by disease category, with the lowest adjusted odds

of implementation in mental health teams.

Implementation was also lower for patients living in more deprived areas (adjusted odds of implementation for patients in the most compared with least deprived areas was 0.60, 95% CI 0.39 to 0.91).

Conclusions Greater multidisciplinary is not necessarily associated with more effective decision making. Explicit goals and procedures are also crucial. Decision implementation should be routinely monitored to ensure the equitable provision of care.

INTRODUCTION

Multidisciplinary team (MDT) meetings are central to the management of chronic disease and they have become widely established across the National Health Service (NHS)^{1–3} and internationally.⁴ Their purpose is to optimise decision making and improve outcomes.⁵ Evidence for their effectiveness, however, is mixed^{6–7} and the degree to which MDTs have been absorbed into clinical practice varies widely across conditions and settings.⁸ Research into the critical factors which impact on MDT effectiveness has identified clear leadership⁶ and explicit, shared goals with measurable outcomes.⁹ A positive team atmosphere or 'climate', defined as shared perceptions of policies, practices and procedures,¹⁰ has also been found to improve performance in some studies¹¹ while others have found no association.¹² Other fundamental determinants of the effectiveness of MDTs have not been established, and so, basic questions, such as the

importance of ‘multidisciplinary’ in practice, have not been addressed.

Uncertainty about some of the features associated with effectiveness has resulted in substantial diversity in the guidance provided regarding MDT meeting structure and processes.^{1 13 14} In the UK, policy for cancer and community mental health teams (CMHTs) lists the professional skills required. Cancer teams follow national standards and are audited to ensure they fulfil requirements including the routine recording of decisions.⁸ In other specialties, such as dementia and cardiovascular disease, the format is locally determined. It is unknown whether such flexibility is appropriate or undermines the productivity of meetings. Patient-related factors may also impact upon MDT decisions. There is evidence that the socio-economically disadvantaged are less likely to receive healthcare¹⁵ despite the focus of NHS policy on equity.¹⁶ If patients’ sociodemographic characteristics influence MDT effectiveness, then explanations such as the influence of patient preferences and comorbidities should be sought.¹⁷

Given the widespread presence of MDTs, the opportunity costs for the NHS of unwarranted variations in team membership and processes and the consequences for patients of inequitable care, we undertook a prospective mixed-methods study of a range of chronic disease MDTs to investigate determinants of effectiveness.

There is debate in the literature concerning the most appropriate indicator of MDT effectiveness. Health outcomes may not be the most suitable measures because they are affected by factors other than the quality of care, including, for example, the extent to which patients adhere to treatment.^{18 19} Additionally, intended health outcomes may not be evident in the short or medium term, and many outcomes are disease specific, making it impractical to compare MDTs for different conditions. Thus, in this context, the use of a process measure, rather than an outcome measure, is appropriate.²⁰

However, the identification of an indicator of high-quality decisions is also difficult. While some decisions can be compared with national guidelines, these seldom specify recommended courses of action for every management decision made for a patient. Additionally, guidelines rarely consider how decisions should be modified for patients with comorbidities or other factors which will influence decision making, such as their social circumstances or preferences. Finally, guidelines are not available for all the conditions considered in MDT meetings. We identified *treatment plan implementation* (as documented in patient notes), as an appropriate process indicator of effectiveness, because it lies on the pathway to health improvement and reflects effective team decision making which has taken account of relevant clinical and non-clinical information, including patient preferences. Another advantage of this measure is that it can be compared across all MDTs.

Our aim was to identify key characteristics of chronic disease MDT meetings associated with decision implementation. To achieve this, we addressed the following objectives: (1) to examine chronic disease MDT meetings to quantitatively identify factors influencing their effectiveness in terms of decision implementation and (2) to explore the reasons for any factors identified through semistructured interviews and non-participant observation of meetings.

METHODS

Design

We undertook a prospective cohort study of MDT meetings in 12 chronic disease adult MDTs across London and North Thames between December 2010 and December 2012. We aimed to include teams which varied in terms of healthcare context, professional mix of team, conditions which affected patients from different parts of the adult life range, and fatal versus life-long conditions. We examined one skin cancer team, one gynaecological cancer team, two haematological cancer teams, two dementia teams, two heart failure teams, and four community mental health teams (including one early intervention service for psychosis).

Data collection

Data were collected from three sources:

Source A: We undertook non-participant observation and audiotaped 370 weekly MDT meetings over 18–55 weeks (depending on patient numbers discussed at each meeting). Each team was observed for 2 weeks before data were collected in order to accustom team members to the observer’s presence. For each patient discussed, we collected quantitative data on decisions made and diagnosis. We also recorded whether health behaviours (smoking, drinking, physical inactivity), other clinical factors (including comorbidities, medical and family history) and patient/carer treatment preferences were mentioned. For the logistic regression, these categories were collapsed into ‘health behaviours or other clinical factors’ (mentioned or not mentioned) and ‘patient/carer preferences’ (mentioned or not mentioned). A decision was defined as a resolution or recommendation about patient management.

After each meeting, field notes were written on MDT features (eg, agenda, attendee job titles, presence of an MDT coordinator), context (eg, reference to national policy/guidance and local resource issues) and process (eg, levels of participation, role of the chair, complexity and uncertainty of problem, and clarity and documentation of decisions).

Core MDT members (as formally defined in MDT documents, or by the clinical lead, and excluding observers and occasional visitors) completed the Team Climate Inventory (TCI) during the final month of observation.¹⁰ This validated measure²¹ assessed

members' perceptions across the four domains of 'team vision', 'participative safety' (ie, a facilitative atmosphere for involvement), 'task orientation' (eg, with respect to individual and team accountability) and 'support for innovation'. A low TCI score reflects perception of poor team climate.

Source B: We conducted semistructured interviews with 53 MDT members recruited from all the MDTs observed, purposively sampled to include core professional groups and frequent and infrequent attendees. Topics discussed included perceptions of the purpose and value of MDT meetings as well as the individual's role and value within the MDT meeting.

Source C: Quantitative data on decision implementation, reasons for non-implementation and patients' sociodemographic (gender, date of birth, and post-code) and diagnostic details were collected from medical records. Decision implementation was assessed 3 months after the MDT meeting unless the MDT explicitly recorded that implementation should be later (eg, 'follow up in six months').

Summary measures

The data were categorised and scored for analysis using the following summary measures:

1. Treatment plan (the unit of analysis)

We analysed each patient's first presentation at an MDT meeting within the observation period. This often resulted in more than one decision being made. These could not be assumed to be independent, and so, decisions were grouped into a 'treatment plan'. Decisions were classified as 'not implemented' if there was no record in the notes indicating decision implementation. In the majority of cases (88%) implementation of the treatment plan was fully determined (by all component decisions being either implemented or not). In cases where some decisions in the plan were implemented and others were not, we classified a treatment plan as implemented if more than 50% of the component decisions were implemented. This definition was agreed to be reasonable by our study team but was investigated further in sensitivity analyses.

2. Team Climate Inventory

Responses for each item on the TCI are given on a 5-point Likert scale. The overall team TCI score was obtained by averaging the scores of team members. We excluded TCIs with more than 25% of items missing in one of the TCI dimensions. A unit increase in TCI score indicates an improvement in team climate (eg, a change from an average response of 'agree' to 'strongly agree').

3. Skill mix (Adjusted Teamman's Index (ATI) and number of professional groups)

We used the ATI²² together with the number of professional groups represented (classified as diagnostic medical practitioner, surgeon, physician, MDT coordinator, nurse, researcher, social worker, allied health professional and psychologist) to measure

skill mix. See online supplementary appendix Section 1. A higher ATI value reflects a more even spread across a greater number of groups.²³ Use of both measures allowed consideration of whether the more complex index added predictive value over a simple count of professional groups. This was measured at each individual meeting, and core and non-core staff were included. Observing students were excluded.

4. Index of Multiple Deprivation

We used the Index of Multiple Deprivation (IMD) 2010 to measure socioeconomic circumstances.²⁴ This is a widely used area-based measure that combines seven domains (income, employment, health and disability, education, skills and training, barriers to housing and services, and crime and living environment) into a single deprivation score for each small geographical area (ie, each 'lower layer super output area' (LSOA), covering about 1500 people) in England. We grouped IMD scores into quintiles, with higher quintiles denoting more deprivation. The post-code address of each patient was linked to the LSOA and the corresponding deprivation quintile.

Quantitative analysis

The influence of MDT and patient-related factors on treatment plan implementation was investigated using random effects logistic regression models, allowing for clustering by MDT. We fitted unadjusted models for each factor of interest. We then undertook the following predefined selection process to obtain a final adjusted model. Initially, we fitted two separate models. Model 1 included patient characteristics (age, gender and IMD quintile), and Model 2 considered MDT and decision-related characteristics (TCI score, disease type, ATI score, number of professional groups, mention of patient preferences and other clinical factors (defined as health behaviours, comorbidities, medical and family history). Factors identified as having potential importance from these models ($p < 0.3$)²⁵ were then fitted in the final model (Model 3).

The suitability of models was investigated, including considering normality of the random effect, goodness of fit (Hosmer Lemeshow) and evidence of overfitting (using bootstrapping). We examined the pattern and extent of missing data and considered its potential impact on our results. We also undertook exploratory investigations to understand further the associations observed in our model and whether these differed by disease type. We extended Model 3 to examine interaction terms between the number of professional groups and disease type and between IMD and guideline-driven cancer compared with non-cancer MDTs.

Planned sample size

The sample size calculation was based on decision implementation, assuming one decision for each patient.

As patients could have more than one decision when presented at an MDT, and these could not be assumed to be independent, we grouped these decisions to consider implementation of their overall 'treatment plan' for analysis. Where patients were discussed at more than one MDT, we analysed the treatment plan from their first presentation during the observation period.

We calculated the sample size using the conservative assumption (based on published research and clinical experience) that 18% of decisions would not be implemented.²⁶ Using Peduzzi's rule of 10, we required 80 non-implemented decisions to estimate eight coefficients in our regression model; this would require approximately 440 patients.²⁷ To allow for clustering by MDT, the sample size was inflated using estimates of the intracluster correlation coefficient (ICC) and the average cluster size. Directly relevant estimates for the ICC were not available, however, published models associating the ICC and outcome prevalence for a range of outcomes in community and health services settings suggested an ICC between 0.01 and 0.05.²⁸ Thus, we assumed an ICC of 0.025, and that across MDTs the average number of patients with relevant decisions during the study would be approximately 230. Based on this information, we aimed to include 3000 patients with a decision from the 12 MDTs.

Qualitative analysis

Qualitative observational and interview data were used to explore possible reasons for variations in implementation across teams and disease types. Our approach used deductive themes based on the main quantitative findings and inductive coding to expand on the deductive codes and to explore relevant emerging issues.

For the interview analysis, all transcripts were coded, checked and analysed in a constant comparative manner by three field researchers using NVivo software (V9). For the observational analysis, we coded field notes for the first 16 meetings observed for each of the 12 MDTs (excluding 2 weeks of pilot observation with each team) and selectively transcribed portions of these. Having listened to all 370 meetings at least twice, the researchers were confident that the 192 meetings coded in this way were representative.

Having coded approximately 1/3 of the data, we found that our coding framework became stable. During analysis of the remaining data we did not need to add further codes to describe the data in relation to our aims and develop a meaningful and useful interpretation, suggesting a sufficiently high level of saturation.²⁹

Analytic meetings involving the wider research team were held to review, refine and cluster the codes into organising themes, resolve disagreements and ensure

consistency of interpretation. Conducting qualitative analysis as a team safeguarded against bias, and facilitated a richer conceptual analysis and interpretation.³⁰ Qualitative data were then triangulated to examine the consistency and internal validity of findings, identifying patterns of convergence in order to develop a coherent framework for understanding the results overall. Further details are provided in the online supplementary appendix Section 2.

RESULTS

We observed 370 MDT meetings during which 3184 patients were discussed. There was considerable variability among the 12 teams in the number of patients discussed at each meeting. The average for each team ranged from 4 to 49 patients. The meeting size across the 12 MDTs ranged between 5 and 28 members, with 1–7 professional groups represented (a median of 4).

Quantitative results (objective 1)

Overall, 2654 patients had a treatment plan with an average of 1.6 decisions per plan. Two thousand five hundred and twelve (95%) patients had adequate implementation data recorded, of whom 1967 (78%) had implemented plans. Implementation was highest in the gynaecological cancer team and lowest in the CMHTs (table 1). There was a trend for non-implementation with increasing patient deprivation.

Adjusted associations (table 2) showed no evidence of a relationship between treatment plan implementation and patient age or gender, or with discussion of patient preferences or health behaviours/other clinical factors. ATI and number of professional groups were highly correlated (correlation coefficient 0.8) and did not appear to have an association when fitted together (Model 2). When included individually in the model, however, each showed a relationship such that increases in team diversity or number of professional groups were associated with a reduced odds of treatment plan implementation (table 2 footnote).

Factors with an association ($p < 0.3$)²⁵ in Models 1 and 2 were fitted together in the final model (Model 3). The adjusted odds of implementation almost doubled (OR 1.96 (95% CI 1.15 to 3.31) for a unit increase in TCI score (indicating improved team climate). By contrast, the adjusted odds of implementation was reduced by 25% for each additional professional group represented and was lower for patients living in more deprived IMD quintiles. Adjusted odds of implementation also varied by disease type.

We had sufficient data on 2512 (92%) patients to include them in the final model. Data were missing for age (2%), IMD quintile (6%) and treatment plan implementation (5%), mainly because of missing patient notes. The only characteristic associated with missingness was MDT disease type. Given the small proportion of missing values, we did not consider it necessary to account for this in our analysis.

Table 1 Frequency (%) of treatment plan implementation by patient, MDT and discussion characteristics

	Treatment plan implemented (number (%))
Age (years) (n=2504)	
20–39	355 (73)
40–59	488 (79)
60–79	739 (81)
80+	381 (80)
Gender	
Males	945 (78)
Females	1022 (79)
Index of multiple deprivation (IMD) quintile (n=2431)	
Least deprived	197 (85)
2	331 (82)
3	395 (82)
4	541 (76)
Most deprived	442 (73)
Team Climate Inventory (TCI)*†	
<4 (median score)	853 (78)
≥4	1114 (79)
Type of disease team*	
Haematological cancer	502 (81)
Community mental health	403 (70)
Dementia	362 (81)
Heart failure	243 (80)
Skin cancer	229 (78)
Gynaecological cancer	228 (84)
Adjusted Teachman's‡	
<1.2	349 (82)
1.2 to 1.4	538 (76)
1.4 to 1.6	591 (78)
>1.6	489 (78)
Number of professional groups†	
1–3	312 (81)
4–5	1199 (77)
6–7	456 (79)
Patient preferences considered	
Yes	361 (75)
No	1606 (79)
Health behaviours/other clinical factors mentioned	
Yes	1069 (79)
No	898 (77)

*Measures recorded for individual teams.

†Measures recorded for individual meetings.

‡Average team response rate=76%.

MDT, Multidisciplinary team.

Sensitivity analyses for Model 3 included: adjusting for the number of decisions making up the first treatment plan (which varied between 1 and 11 decisions); examining the impact of using the first recorded treatment plan in analysis by refitting the model based on a randomly chosen treatment plan for each patient; collapsing the 5 IMD quintiles to two groups (IMD1–3 and IMD 4–5) to produce an 8 coefficient

model; refitting the model with implemented treatment plans redefined as those with greater than 80% of component decisions implemented (a change which had little impact on the overall implementation rate reducing it from 78% to 74%); and refitting the model excluding the CMHTs (which made up a large proportion of the teams in the study). None of these sensitivity analyses substantially changed our conclusions.

We further explored the observed trend between implementation and number of professional groups to consider whether this might be dependent on disease type. Tabulations showed that for dementia teams and CMHTs this trend was apparent. For the other disease types, however, such a trend was not obvious. An interaction term added to Model 3 indicated some evidence of a differential effect by type of disease ($p=0.06$), however, we note that this exploratory result should be interpreted cautiously, as for some diseases, there was limited variability in the number of professional categories represented. We also considered whether the relationship between IMD and implementation differed for cancer and non-cancer specialties. In all cases, the observed general trend was for less implementation in more deprived groups. An interaction term included in Model 3 was not significant ($p=0.13$).

The reasons for non-implementation of treatment plans are summarised in table 3. Patient-led reasons were recorded most frequently in CMHTs (eg, due to patient non-attendance), while patient death was reported most frequently for heart failure MDTs (see online supplementary appendix. Section 3 summarises reasons for non-implementation by disease type). We also collapsed the 5 IMD quintiles to two groups (IMD1–3 and IMD 4–5), and found that reasons for non-implementation were similar, although patient death was a more frequent reason for non-implementation in the least deprived group (data not shown). The 'other' reasons were diverse, and included cases where the decision was implemented outside the 3-month follow-up period, or when new information or test results emerged after the MDT meeting. This category also included cases where it was subsequently decided that a referral had been inappropriate or that a patient should have been referred to a team in a different catchment area.

Qualitative results (objective II)

Features of teams with higher rates of treatment plan implementation

High implementing MDTs, regardless of disease type, had clear goals and more frequently referred to diagnostic or treatment protocols and national guidelines. All four cancer teams adhered closely to national guidelines, and so, had the dedicated administrative support members considered to be essential for meeting preparation and facilitation. High implementing teams also tended to have permanent chairs who

Table 2 Associations between treatment plan implementation and patient and team characteristics; unadjusted and adjusted results from logistic regression models allowing for clustering by team*

	Unadjusted (n=2512)†		Adjusted Model 1 (n=2431)		Adjusted Model 2 (n=2512)		Adjusted Model 3 (n=2431)	
	OR (95% CI)	p Value	OR (95% CI)	p Value	OR (95% CI)	p Value	OR (95% CI)	p Value
Age (at first decision) (1 year increase)	1.00 (0.99 to 1.01)	0.60	1.00 (0.99 to 1.01)	0.84				
Gender								
Male	1		1					
Female	0.99 (0.80 to 1.21)	0.89	1.01 (0.82 to 1.24)	0.96				
IMD quintile								
Least deprived	1		1				1	
2	0.83 (0.53 to 1.30)		0.83 (0.53 to 1.30)				0.80 (0.52 to 1.25)	
3	0.91 (0.58 to 1.40)		0.91 (0.58 to 1.40)				0.87 (0.56 to 1.34)	
4	0.64 (0.43 to 0.98)		0.65 (0.43 to 0.99)				0.64 (0.42 to 0.97)	
Most deprived	0.60 (0.39 to 0.93)	0.04	0.60 (0.39 to 0.93)	0.04			0.60 (0.39 to 0.91)	0.05
TCI (1 unit increase)	1.68 (0.70 to 4.03)	0.25			2.28 (1.30 to 4.00)	0.004	1.96 (1.15 to 3.31)	0.01
Type of disease team								
Haematological cancer	1				1		1	
Community mental health	0.56 (0.35 to 0.90)				0.60 (0.37 to 0.99)		0.57 (0.39 to 0.82)	
Dementia	1.21 (0.67 to 2.20)				1.11 (0.74 to 1.67)		1.05 (0.76 to 1.45)	
Heart failure	0.93 (0.52 to 1.54)	0.03			0.78 (0.49 to 1.21)	<0.001	0.75 (0.50 to 1.14)	<0.001
Skin cancer	0.81 (0.42 to 1.56)				0.97 (0.67 to 1.39)		0.97 (0.67 to 1.39)	
Gynaecological cancer	1.22 (0.62 to 2.38)				2.76 (1.58 to 4.83)		2.48 (1.48 to 4.15)	
Adjusted Teachman's (ATI) (1 unit increase)	0.64 (0.35 to 1.17)	0.15			0.65 (0.24 to 1.76)‡	0.40		
Number of professional groups	0.90 (0.77 to 1.06)	0.21			0.84 (0.65 to 1.10)‡	0.21	0.75 (0.66 to 0.87)	<0.001
Patient preferences considered								
No	1	0.24			1	0.34		
Yes	0.86 (0.67 to 1.11)				0.89 (0.69 to 1.14)			
Health behaviours/other clinical factors mentioned								
No	1	0.80			1	0.55		
Yes	1.03 (0.83 to 1.27)				1.07 (0.86 to 1.32)			

*Intra cluster correlation coefficient for team clustering=0.05 (bootstrap 95% CI 0.01 to 0.08).

†For age n=2504 and for IMD quintile n=2431.

‡ATI and number of professional groups are highly correlated (correlation coefficient 0.8). When included individually in model 2, each showed a significant relationship: OR for ATI=0.38 (95% CI 0.23 to 0.63) p<0.001, OR for number of professional groups=0.76 (95% CI 0.67 to 0.87) p<0.001.

IMD, Index of Multiple Deprivation; TCI, Team Climate Inventory.

Table 3 Reasons for non-implementation for decisions in the first treatment plan

Reason for non-implementation of treatment decision*	Number (%) n=355
Patient/carer/family choice	54 (15)
Change in circumstances†	40 (11)
Patient did not attend	36 (10)
Decision was conditional and condition was not met	21 (6)
Patient died	19 (5)
Comorbidity arising post-MDT meeting, or deteriorated post-MDT meeting	6 (2)
Comorbidity not discussed	7 (2)
Other‡	98 (28)
Non-implementation recorded but reason not given	74 (21)

*Where non-implementation was recorded in the notes.

†For example, patient left the care of team.

‡New information or test results emerged after the MDT meeting; incorrect or missing information at the MDT meeting; decision was implemented outside of the 3-month follow-up period. MDT, Multidisciplinary team.

maintained a focus on decisions, which were clearly recorded. They also assembled patient lists before meetings. This stimulated case presenters to consider the management options they wished to discuss before rather than during the meeting and led to more explicit decisions. The other MDTs included none or some of these features, and this varied by team rather than by disease type.

Features of teams with lower rates of treatment plan implementation
Those dementia and CMHT meetings with larger numbers of professional groups and lower implementation tended to discuss a more diverse range of issues (from medication to social issues, housing and benefits), and also used meetings to provide updates on ongoing cases and peer support. There was some evidence that these teams lacked clarity of purpose:

I am never quite sure what the purpose of the meetings are (psychiatric nurse, interview),

and were less focused on specific questions:

Thanks for sharing that story. Why did we hear it? (psychiatrist, observation).

Decision documentation was inconsistent, and CMHT members frequently discussed difficulties in engaging patients with the service which also contributed to the low implementation in these teams.

Chairing arrangements

Chairing varied considerably between teams. Most meetings were formally chaired: in cancer teams, one dementia team and two CMHTs, this was a designated person who chaired the meeting each week (either a consultant or the team manager). In two mental health teams, the chairing role rotated between team members on a weekly basis. The remaining three teams did not have a predefined chairing system, and

different senior members took the lead on different occasions, sometimes changing during a meeting.

Multidisciplinary working

Team members reported that they valued hearing a range of disciplinary perspectives, however, not all disciplines were perceived to have an equal 'voice'. Cancer and heart failure teams were characterised by a strong medical dominance in terms of attendance and participation. While these teams typically made and implemented high numbers of treatment plans, those plans were less likely to have incorporated the full range of disciplinary perspectives:

It's rarely a multidisciplinary meeting...it often consists of a surgeon talking to the radiologist (gynaecological cancer oncologist, interview).

CMHT and dementia teams were characterised by more even levels of participation across the disciplines, however, interviews revealed that differences in the ways that professional groups approached problems could lead to difficulties:

They're in two camps... social workers very much do try to defend, you know, a person's right to be mad. I mean the nurse view is 'you're not well so we need to get you on the path and let's make the decisions you would make [if you were well]' (psychiatric nurse, interview).

Patient factors

We explored the roles that patient preference, health behaviours and other clinical factors may have in explaining the socioeconomic variations in implementation that we found. However, most members considered that the extent to which patient behaviours and other factors were discussed was appropriate, although there was marked team variation in discussion of these factors. With regard to patient preferences, some argued that these were central to MDT decisions while others tended to elicit patient preferences after the MDT, when treatment options could be shared with them.

Further quotes illustrating these findings are provided in Section 4 of the online supplementary appendix.

DISCUSSION

In this large study, the first to include MDTs for different conditions, we demonstrate the implications of MDT diversity for the NHS and patient care. We have shown that a good team climate and less diverse membership in the MDT were the most important predictors of treatment plan implementation across teams. There was variation within and between disease types with gynaecological cancer having the highest rates of treatment plan implementation, and CMHTs the lowest. There was less implementation for patients living in more deprived areas. Lack of implementation

was commonly due to patient or family choice, and to difficulties in engaging patients with the service. The better implementing teams tended to have dedicated administrative support and clear goals and processes.

Contrary to previous reports and expectations, greater multidisciplinary is not necessarily associated with more effective decision making. Previous research suggests that each team member brings relevant information for the development of a cohesive care plan.³¹ However, diversity may raise communication barriers due to differences in knowledge, skills and ability,⁹ misunderstandings of each other's roles,³² and identifying with subgroups rather than with the team as a whole.³³ Our research suggests that the presence of many professional groups needs to be mediated by a clear purpose and agreed processes. This is supported by evidence which points to the benefits of shared objectives to guide and structure communication, focused leadership, and team reflexivity.^{9 34}

Second, our results concur with others which demonstrated that a good team climate *does* translate to better decisions.¹¹ It had been suggested that transformational leadership affects team performance (better decisions) by creating a positive climate.³⁵ It is also possible that the mixed results in the literature are explained by the different outcome measures used to define effectiveness.¹²

Finally, patients from more deprived areas are less likely to have their treatment plans implemented, and this occurred despite the routine reference to treatment guidelines by cancer teams. Consideration of patient preference, comorbidities or other health-related factors do not seem to explain this.

Previous research reporting socioeconomic inequalities in use of adjuvant therapy for cancer suggests that non-implementation equates to non-uptake of care for cancer patients.³⁶ This is likely to partly explain the continuing socioeconomic variations in cancer survival.³⁷ There is little research on treatment inequalities for people with dementia, although a small study indicates that these may occur.³⁸ Recent models demonstrated equitable provision of cardiovascular care which translated to similar proportions of deaths averted across deprivation quintiles.³⁹ However, non-implementation may result in care delays which might impact upon morbidity rather than mortality—something that was not addressed in these cardiovascular models.

Methodological issues

We recognise that the use of decision implementation as an indicator of effectiveness does not address the issue of whether or not the 'right' decisions have been made. It is possible that poor decisions are implemented. In order to examine whether implemented decisions are 'good decisions' that do indeed lead to patient benefit, it would be necessary to analyse

carefully identified disease-specific health outcomes which can be plausibly and directly related to the MDT decision. Alternatively, a subset of decisions about which there are specific best practice guidelines could be assessed according to whether they conform to this guidance. However, many MDT decisions cannot be derived directly from treatment guidelines, and the detail provided in such guidelines varies by specialty.

Additionally, the factors we considered in our analyses were identified as potentially important based on previous research. We appreciate that there may be other, unmeasured factors that could also have influenced implementation. Furthermore, decision making is only one of a range of functions for some MDT meetings, and in particular for the CMHTs we studied. Our outcome measure was not designed to assess how well these additional functions were performed.

When deciding which and how many chronic diseases to include, in addition to the criteria described above, we were also bound by pragmatic imperatives to ensure feasibility of data collection. We recognise that this has implications for the generalisability of our results, in terms of applicability to other chronic conditions and with respect to the similarity of the MDTs we examined in comparison to other MDTs for the conditions under study. For this reason, we included more than one MDT wherever possible. Online supplementary appendix Sections 5 and 6 report team and meeting characteristics to assist readers in assessing the extent to which our results are likely to be applicable to other teams.

We combined decisions where implementation was 'not documented' with those decisions which were 'not implemented'. This was because, on the basis of our clinical experience, non-implementation is commonly not explicitly recorded in patients' records. Our conclusions are, therefore, limited by the accuracy of record keeping.

There is no consensus on the best measure of skill mix or team diversity.²³ We therefore categorised professionals into coherent groups on the basis of our clinical expertise. We used a well-established area measure of socioeconomic characteristics, commonly used where individual-level indicators are not available. However, this method rests on the assumption that individuals conform to the socioeconomic profile of their residential area. We recognise that misclassifications can cause underestimates or overestimates of the relation between socioeconomic circumstances and implementation.

We did not achieve the target sample size of 3000 individual patients with treatment plans. This is because fewer patients than anticipated had treatment plans agreed at each meeting. However, even with our smaller sample, investigation into model overfitting did not raise concerns.

We did not collect cost or waiting time data, and so, cannot comment on the implications of MDT diversity with respect to MDT cost effectiveness or consequences for patients.

It is possible that team members behaved differently when under observation, but this was mitigated by the 2 weeks of observation before data were collected. Additionally, MDT members were aware that decision making was being studied, but not that implementation was being examined.

Conclusion

MDTs are widespread across the NHS, but they are resource intensive, and so their value to the NHS and patients should be maximised. A team atmosphere that facilitates involvement, task orientation and support for improvement is key to ensuring team decisions are implemented. The benefits of multidisciplinary per se should not be assumed. However, clear goals and procedures are crucial, and we also recommend routinely monitoring decision implementation to ensure the equitable provision of care.

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CN, IW and PX contributed to study design, review of the literature, recruitment of participants, data collection, analysis and interpretation, assisted in writing the first draft of the paper, and provided critical review of subsequent drafts. JB collaborated in the funding application and was responsible for statistical aspects of the study, including involvement in the study design, analysis, and interpretation. JMB, AC, SG, MK, AL, GL, SM and AP collaborated in developing the idea for the research and in the funding application. They contributed to study design and provided clinical expertise throughout the project. DA, MH, AC, AL, GL and AP contributed to participant recruitment. AL and AC contributed to the qualitative analysis and interpretation of the findings. DA and MH contributed to study design, and provided guidance from a patient perspective throughout the project. NA-P assisted with the literature review and data collection. As the chief investigator and guarantor, RR managed the study overall and had final responsibility for the analysis and manuscript content.

Declaration of transparency The lead author affirms that the manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study, as planned, have been explained.

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Appendix

Section 1: Further detail on professional categories for skill-mix

Diagnostic Medical Practitioner: includes radiologist, pathologist, nuclear medicine, clinical scientists

Surgeon: includes sub-specialist trainees, specialist registrars and consultants

Physician: includes junior doctors, consultant and staff grade doctors (medical students were excluded)

MDT Coordinator: includes individuals where the focus of their role is on facilitating the smooth running of the meeting, may have limited clinical input, prepare notes for patients discussed and take minutes (MDT Co-ordinator may not be their official job title)

Nurse: includes clinical nurse specialists, community psychiatric nurses, palliative care nurses and visiting crisis team nurses

Researcher: includes clinical research fellows, research nurses, clinical trials practitioners, and clinical trials co-ordinators

Social Worker

Allied Health Professional: includes occupational therapist, support workers and Age Concern representatives

Psychologist: includes assistant psychologists and clinical psychologists.

Section 2: Supplementary detail on Qualitative Methodology

We devised a strategy for qualitative data analysis which allowed us to:

- manage a very large volume of data within the project's time-frame and to
- achieve our research objectives while allowing new themes to emerge.

Our approach used both deductive themes (based on the main quantitative findings) and inductive coding (based on a larger qualitative analysis).

The analysis was an iterative process; analytic meetings were used to scrutinise and revise codes and themes, using ethnographic methods such as constant comparison and coding frame revisions. An overview of the steps taken to analyse each data source is described below.

2.1 MDT meeting nonparticipant observations

2.1.1 Inductive coding

- Observational field notes for the first 16 meetings observed for each of the 12 MDTs recruited to the study were analysed. These field notes were entered into a structured proforma, categorised according to the research objectives and previous literature. This included sections on organisational characteristics, features of the team and task, mediators of team processes and outcomes.
- The completed proformas were coded in NVivo 9. Recurring or salient issues were compiled into an initial coding framework, and exceptions were noted within the relevant codes.
- This coding framework was used to identify and selectively transcribe¹ at least two discussions illustrating each code.
- The transcripts were imported into the NVivo database and were read, re-read and coded using the initial coding framework. This was revised iteratively and additional codes were added where new issues arose. This process continued throughout the analysis.

¹ See Emerson, R., Fretz, R., & Shaw, L. Writing Ethnographic Fieldnotes. Chicago: University of Chicago Press. 1995

2.1.2 Deductive coding

Each main quantitative finding formed the basis for a deductive theme. We identified the inductive codes that were relevant to each of these quantitative results, allowing us to explore possible reasons for each finding. This analysis was conducted during regular analytic meetings between the researchers (CN, IW & PX) the PI (RR) and two co-applicants (AL & AC).

2.2 MDT Member Interviews

- We conducted 53 semi-structured interviews, which were transcribed verbatim and analysed thematically using NVivo 9.
- Deductive themes were generated from the research objectives (from which the interview guide was developed) as well as from the preliminary analysis of the observations of the MDT meetings.
- Two researchers initially independently coded 20% of the transcripts. Any discrepancies were discussed by the two coders, with input from a third researcher where there was disagreement. This process helped to ensure consistent coding of the remaining transcripts.
- These themes were then *inductively* analysed, generating sub-themes, which allowed relevant issues identified in the data to be explored. The example below illustrates these levels of analysis:

Deductive Theme	Examples of Inductive Sub-themes	Examples of Codes
Added value of MDT with respect to decision making	Improving decision making (short term)	Consistency of decision making (acting as a 'check')
		Having access to all the information to inform decision making
	Context within which MDT decision making is most helpful	When the 'right' people attend
		When there is good leadership/management
		When people make meaningful, significant contributions
	Difference as strength	Sharing professional knowledge and expertise
		Providing a different perspective

2.3 Data Synthesis

The qualitative data obtained from non-participant observation of the MDTs (i.e. the audio-recordings and fieldnotes) and member interviews were triangulated to explain or provide additional information about the quantitative findings, and to assess the consistency and internal validity of the results. To achieve this, the themes derived from the analysis of interview and observational data were comprehensively charted for ease of comparison and to allow us to work back and forth between and within the different data sources.

2.4 Quality Assurance of qualitative data collection and analysis

Observations

The observational field notes focused on significant events and interactions observed by the researcher. Within 24 hours of each meeting, the researcher categorised these field notes according to an observation coding sheet. This provided a framework to map out the potential factors influencing implementation of MDT decisions. The researcher also listened to the audio recording of each meeting, which provided a further opportunity to add notes and the times of key events on the recordings for future reference. Although the field researchers were not clinicians, clinical members of the research team (the PI and several of the study co-applicants) were involved throughout data collection and analysis, and were available to respond to any specific queries the field workers had throughout the project (e.g. relating to specialist terminology).

Observation notes and selective transcripts of the meeting discussions were coded and analysed in a constant comparative manner, with repeated inspection of each data source between three researchers, and at regular analytic conferences with other members of the research team. As new codes were introduced, they were assigned a working definition to ensure they were used consistently by the different researchers. These definitions were debated and revised repeatedly throughout the process. The analytic conferences allowed the researchers to check whether codes were being applied according to the definition, and that definitions were iteratively revised where appropriate. The analytic conferences also facilitated group reflexivity and safeguarded against individual bias by providing opportunities to make each researcher's assumptions explicit and open to challenge. Together with regular meetings between the field researchers, the chief investigator and other members of the team, these formed an audit process, ensuring that interpretations were firmly supported by the data.

Professional interviews

In order to establish consistency of coding for the interview data, two researchers initially independently coded 20% of the transcripts. Following this, the researchers met to discuss any incongruence, going through each transcript line by line to check for differences both in terms of sections coded, and the specific code applied in each case. Differences were resolved by discussing the differing interpretations, identifying any misunderstandings, and refining code definitions as necessary. A third researcher was present to give an independent perspective if the two coders failed to reach agreement.

Steering group meetings

Throughout the study, we convened four steering group meetings (between July 2011 and March 2013) which provided a mechanism for peer review and guidance. In these meetings, as well as providing general support and advice (i.e. with recruitment), the steering group members discussed methodological issues, reviewed the definitions of variables and outcomes and the interview topic guides, and helped to develop data auditing strategies, hence providing further quality assurance. The Steering Group included two Patient and Public Involvement representatives who were actively involved throughout. They attended steering group meetings, and provided in depth and valuable contributions to our study design and analysis.

Section 3: Reasons for non-implementation for decisions in the first treatment plan by specialty (Number (%))*

	Gynaecological Cancer	Haematological Cancer	Skin Cancer	Community Mental Health	Heart Failure	Dementia	Total
Reason for non-implementation of treatment decision	N=40	N=109	N=48	N=102	N=25	N=31	N=355
Patient / carer / family choice	7 (18%)	12 (11%)	10 (21%)	16 (16%)	3 (12%)	6 (19%)	54 (15%)
Change in circumstances***	5 (13%)	12 (11%)	0	19 (19%)	4 (16%)	0	40 (11%)
Patient did not attend	2 (5%)	6 (6%)	3 (6%)	25 (25%)	0	0	36 (10%)
Decision was conditional and condition was not met	6 (15%)	6 (6%)	5 (10%)	4 (4%)	0	0	21 (6%)
Patient died	3 (8%)	7 (6%)	1 (2%)	0	8 (32%)	0	19 (5%)
Comorbidity arising post MDT meeting or deteriorated post MDT meeting	2 (5%)	3 (3%)	1 (2%)	0	0	0	6 (2%)
Comorbidity not discussed	2 (5%)	4 (4%)	1 (2%)	0	0	0	7 (2%)
Other**	4 (10%)	36 (33%)	17 (35%)	29 (28%)	4 (16%)	8 (26%)	98 (28%)
Non-implementation recorded but reason not given	9 (22%)	23 (21%)	10 (21%)	9 (9%)	6 (24%)	17 (55%)	75 (21%)

* For 306 decisions there was no record of whether or not the decision was implemented. In analysis these were considered as non-implemented decisions.

** e.g. new information or test results emerged after the MDT meeting; incorrect or missing information at the MDT meeting; decision was implemented outside of the 3 month follow-up period.

*** e.g. patient left the care of team

Section 4: Qualitative Results - illustrative quotes

Below we provide illustrative quotes to support the findings discussed in the Qualitative Results section of the paper. These are taken from transcripts of interviews and MDT meetings.

3.1 Quotes illustrating the importance of clear MDT meeting goals

Teams with clear goals

'The role [of the meeting] is to make patient decisions and in particular treatment decisions or management decisions for patients here.' (Haematology Consultant, interview)

Teams without clear goals

'I am never quite sure what the purpose of the meetings are ... It was the thing that was done and therefore I did not have any say on whether it was done or not done.' (Community Psychiatric Nurse, interview)

3.2 Quote illustrating frequently referencing protocols and guidelines

'In our guidelines we do acknowledge that we can offer 6 ABVD [chemotherapy treatment] instead and no radiotherapy and of course we don't know if it's equally efficacious but that is the alternative isn't it from our guidelines' (Haematology Consultant, observational data)

3.3 Quote illustrating importance of dedicated administrative support

'She's great [MDT co-ordinator]. And she will remind everyone why people weren't discussed when or what they do or how they should be going. She's brilliant. She really is. She holds the meeting together very well I think.' (Clinical Nurse Specialist, interview)

3.4 Quote illustrating the value of strong permanent Chairs

'I think one of the weaknesses is everyone chairing ... [senior people chairing] makes a little bit more sense because then that person can (deliver) their control of the group a bit more.' (Community Psychiatric Nurse, interview)

3.5 Quote illustrating difficulties in engaging patients

Transcript from Community Mental Health Team (CMHT) meeting:

Social Worker: *we haven't managed to make a difference at all actually. We're just chasing him and trying to make him take medication, which he doesn't want to take.*

Nurse: *Not very successfully...*

Psychologist: *It seems destined to fail*

3.6 Quote illustrating belief that patient preferences, health behaviours and other clinical factors are considered where appropriate

'I think we discuss it when it's important ... yes we do bring in physical problems as well which we need to if necessary' (Dementia Occupational Therapist, interview)

3.7 Quotes illustrating different opinions regarding the most appropriate time to elicit patient preferences

'We always ask [the person presenting the case] "What does the client want, what do they want, what do they expect from coming here?" ... sometimes the person doesn't know because they didn't ask the client ... it makes them think, "Well I should have checked. I have to go back and check this now," so the decision will be that they might have to see the client again ... It makes you look like you did an incomplete assessment because that's a basic thing you should be checking.' (Community Psychiatric Nurse, interview)

'One of the values of the MDT meeting is to allow the clinician to actually go into a consultation [after the meeting] with a patient and tell them what the options are, tell them how the decision has been reached and what the advantages and disadvantages are, and I think that that's more useful to a patient than actually giving patients a list of options beforehand ... and then having the MDT meeting decide that half those options are off the table anyway' (Medical Oncology Consultant, interview)

Section 5: Team and meeting characteristics

	Haematological Cancer		Gynae. Cancer	Skin Cancer	Dementia		Community Mental Health				Heart Failure	
MDT characteristics	Team 1	Team 2			Team 1	Team 2	Team 1	Team 2	Team 3	Team 4	Team 1	Team 2
TCI score	4.32	3.79	3.49	4.11	4.10	3.89	4.01	3.31	3.64	4.01	4.00	3.75
Meeting characteristics	N=38	N=36	N=18	N=31	N=43	N=25	N=15	N=20	N=55	N=23	N=42	N=24
Number of patients discussed per meeting: Mean (SD)	14.5 (4.1)	14.2 (4.8)	34.5 (5.0)	21.7 (5.6)	11.2 (5.4)	4.3 (1.3)	29.1 (11.5)	14.6 (4.4)	14.0 (4.9)	49.3 (12.1)	8.0 (2.3)	6.0 (2.2)
Adjusted Teachman's score: Mean (SD)	1.38 (0.14)	1.29 (0.10)	1.70 (0.12)	1.52 (0.12)	1.75 (0.14)	0.86 (0.33)	1.26 (0.17)	1.34 (0.14)	1.34 (0.13)	1.47 (0.08)	1.36 (0.13)	0.89 (0.14)
Number of professional categories represented: Median (25 th -75 th percentile)	5 (4-5)	5 (5-5)	6(6-6)	6 (5-6)	5 (5-6)	3 (2-3)	3 (3-4)	4(3-4)	4(3-4)	4 (4-4)	4 (4-5)	2 (2-2)
Number of MDT members at the meeting*: Mean (SD)	11.79 (1.65)	28.25 (4.43)	18.28 (2.89)	17.48 (2.66)	9.23 (1.60)	6.92 (1.75)	7.73 (2.60)	8.35 (2.13)	9.09 (2.21)	9.70 (1.94)	15.02 (2.96)	5.38 (1.58)
Number of patients discussed during observation period (at least once)	390	371	324	384	403	106	231	134	314	169	225	133
Patients with at least one treatment plan: Number (%)	330 (85%)	321 (87%)	281 (87%)	335 (87%)	356 (88%)	106 (100%)	145 (63%)	71 (53%)	251 (80%)	131 (76%)	197 (88%)	130 (98%)

Section 6: Meeting characteristics

Team	No. of patients discussed	Approximate duration of meeting (hours)	No. of professional categories in attendance (min-max)	No. of core team members	Chair	Administrative support for meeting
Gynaecological Cancer	35	2.5	5-7	28	Doctor	MDT coordinator
Haematological Cancer 1	15	1	4-5	17	Doctor	MDT coordinator
Haematological Cancer 2	14	1	5	45	Doctor	MDT coordinator
Skin Cancer	22	1.5	5-6	21	Doctor	MDT coordinator
CMHT 1	29	2.5	3-4	12	Social Worker	None
CMHT 2	15	1	3-4	12	Rotating Chair	Administrator records minutes
CMHT 3	14	1	3-4	15	Rotating Chair	Administrator records minutes
CMHT 4	49	2.5	4	16	Social Worker	None
Heart Failure 1	8	1.5	4-5	30	Doctor	None
Heart Failure 2	6	2	2	8	No formal Chair – varied throughout discussion	None
Dementia 1	11	1	4-6	15	Doctor or Nurse	Provided by Team Manager
Dementia 2	4	1.5	1-4	13	No formal Chair – varied throughout discussion	None