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Predictors of Treatment Decisions in Multidisciplinary Oncology Meetings: A Quantitative Observational Study

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ABSTRACT

Background. In many healthcare systems, treatment recommendations for cancer patients are formulated by multidisciplinary tumor boards (MTBs). Evidence suggests that interdisciplinary contributions to case reviews in the meetings are unequal and information-sharing suboptimal, with biomedical information dominating over information on patient comorbidities and psychosocial factors. This study aimed to evaluate how different elements of the decision process affect the teams' ability to reach a decision on first case review.

Methods. This was an observational quantitative assessment of 1045 case reviews from 2010 to 2014 in cancer MTBs using a validated tool, the Metric for the Observation of Decision-making. This tool allows evaluation of the quality of information presentation (case history, radiological, pathological, and psychosocial information, comorbidities, and patient views), and contribution to discussion by individual core specialties (surgeons, oncologists, radiologists, pathologists, and specialist cancer nurses). The teams' ability to reach a decision was a dichotomous outcome variable (yes/no).

Results. Using multiple logistic regression analysis, the significant positive predictors of the teams' ability to reach a decision were patient psychosocial information (odds ratio [OR] 1.35) and the inputs of surgeons (OR 1.62), radiologists (OR 1.48), pathologists (OR 1.23), and oncologists (OR 1.13). The significant negative predictors were patient comorbidity information (OR 0.83) and nursing inputs (OR 0.87).

Conclusions. Multidisciplinary inputs into case reviews and patient psychosocial information stimulate decision making, thereby reinforcing the role of MTBs in cancer care in processing such information. Information on patients' comorbidities, as well as nursing inputs, make decision making harder, possibly indicating that a case is complex and requires more detailed review. Research should further define case complexity and determine ways to better integrate patient psychosocial information into decision making.

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Cancer diagnosis and treatment are complex processes and must be tailored to individual patients. To meet these demands, and to ensure the delivery of safe and high-quality care, cancer patients are reviewed by multidisciplinary tumor boards (MTB), or cancer conferences. Throughout the world, combinations of healthcare professionals, including surgeons, physicians, oncologists, radiologists, pathologists, and specialist cancer nurses comprise MTBs. The specialists participating in MTBs formulate treatment plans to optimize care and improve patient outcomes.[1] As the number of new cancer cases worldwide rises[2,3] against a backdrop of increasing financial pressure,[3,4] the effectiveness of MTBs is central for delivery of patient-centered, high-value care.

Despite a central role in many healthcare systems,[1] evidence supporting the effectiveness of MTBs is unclear,[5] and their performance can be variable.[6] The past decade has seen developments in research on MTBs, with studies examining the team decision-making process, decision implementation, and patient participation. A recurring pattern in decision making is the skewed contribution to case reviews towards physicians and the biomedical aspect of the disease, at the expense of nursing input (even where specialist nurses are formally in attendance), patients' comorbidities, and psychosocial circumstances.[7–9] However, the general consensus is that patient-centered, holistic clinical decisions underpin high-quality patient care.[3,8,10,11] There is evidence that failure to account for patients' social circumstances[12] and comorbidities[9] has a negative impact on the ability of MTBs to implement treatment recommendations.[12] Other studies have shown reduced costs[13] and improved care[14] when decisions are aligned with patients' needs and preferences. The quality of MTB decision making is a cornerstone of effective care planning.

The aim of this study was to assess the relative influence of different elements of the decision-making process on the ability of MTBs to reach clinical decisions. We hypothesize that all aspects of patient information (H1), as well as inputs by all core specialties (H2), will increase the ability of MTBs to make treatment recommendations.

METHODS

Participants and Setting

This is a secondary analysis of an existing anonymized database containing quantitative observational data. The data represent quality assessments of 1045 cancer patient case reviews across four teams specializing in the most common tumors in the UK, namely breast ($n = 224$), colorectal ($n = 185$), lung ($n = 254$), and urological ($n = 382$). The data were collected between 2010 and 2014 from National Health Service hospitals: one teaching university hospital with approximately 1500 beds (lung) and three community hospitals with approximately 500–1000 beds (breast, colorectal, urological). The participating institutions and MTBs operate independently of one another with no crossover of MTB membership. Inclusion criteria were broad, with eligibility for the study being defined as the healthcare staff who are members of a cancer MTB. All teams consisted of a chairperson and coordinator (team administrator), as well as the senior cancer specialists, i.e. surgeons, oncologists, radiologists, pathologists, and cancer nurses, with the exception of lung, where a chest physician was also present.

The data were collected in real-time over 10 consecutive meetings for each tumor type by the researchers, who were surgeons trained in observational assessment (breast, SA; colorectal, SMS; lung, SS; urological, BWL). The researchers were not members of the MTBs that they were assessing. The reliability between evaluators was assessed in a subset of cases scored in pairs as per standard evidence-based recommendation for such analyses.[15] During data collection, each evaluator was blind to the other evaluators' observations in order to minimize bias. All data were collated for analysis by a separate researcher (TS). The participating MTBs had previously been recruited to participate in separate research projects (e.g. Lamb et al.[16], Arora et al.[17], and Shah[18]). At the time of data collection, ethical approvals were in place for all hospitals/teams, and informed consent was obtained verbally from all MTB members (Research Ethics Committee [REC] reference for urology MTB is 10/H0805/32; at lung, colorectal, and breast MTBs the study was reviewed and approved as clinical service evaluation). Patient consent was not required due to the statistical, non-interventional nature of the study.

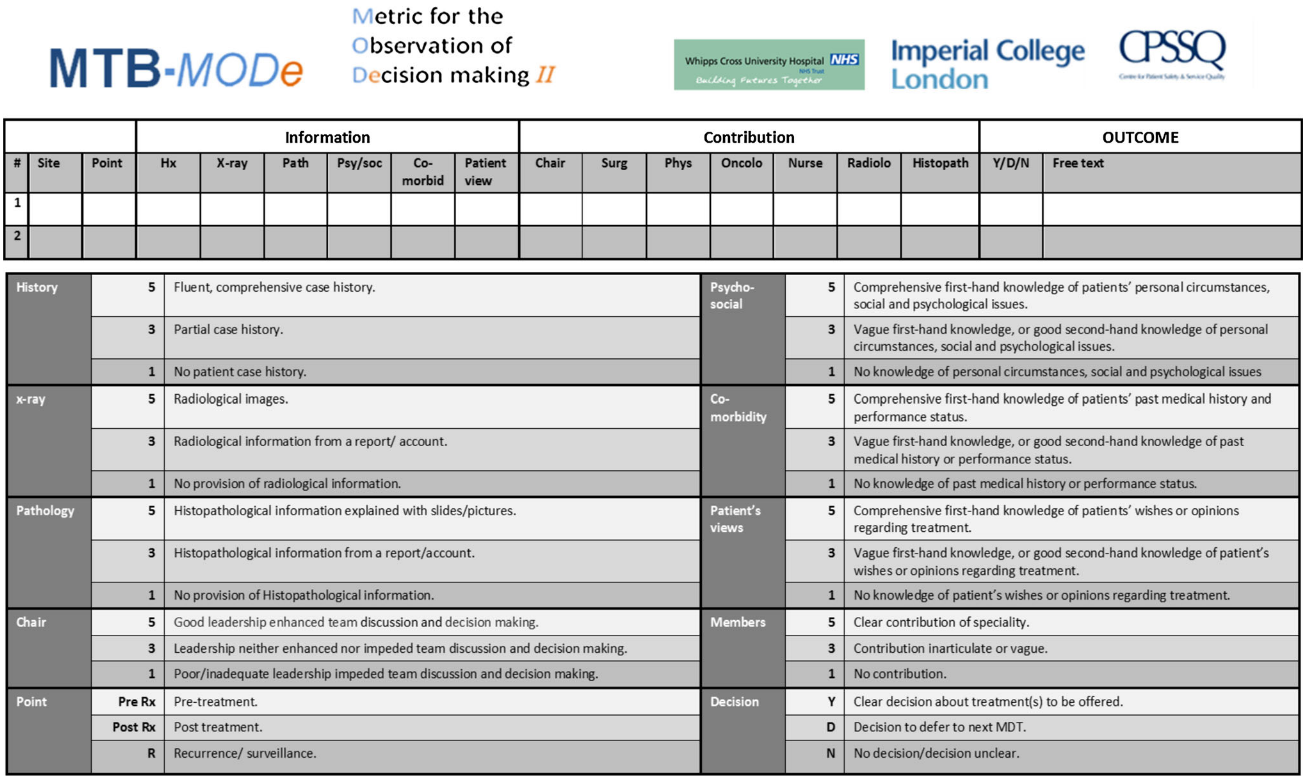
MATERIALS

Cases within each MTB were rated using a validated, behaviorally anchored observational tool, the Metric for the Observation of Decision-Making in MTBs (MTB-MODe) (Fig. 1).[7] The process of tool development and validation has been reported in detail.[7,16], [7,19–21] MTB-MODe allows an evaluator to rate the following elements on 5-point behaviorally anchored scales:

(i) *Quality of information presentation* at the meeting, including patient history, radiology results, pathology results, psychological and social factors, medical and surgical comorbidity, and the patients' wishes or opinions regarding treatment.
(ii) *Quality of contribution to decision making* by MTB members (chairperson, surgeon, oncologist, specialist cancer nurse, radiologist, and histopathologist). Chairing was rated on the basis of the National Cancer Action Team guidelines.[21] Other members were rated on the basis of their specialty contribution based on the scale anchors.

The outcome measure was whether or not a clear treatment decision was reached for a patient (yes/no).

No patient-identifiable or further clinical data were collected as the focus of the study was on the clinical decision process within the MTB. The study dataset was distinct from the clinical data collected by the MTB administrator and used for care planning, and was not revealed to members of the MTB during the study in order to minimize any biases.



MTB-MODe

Metric for the Observation of Decision making II

Whipps Cross University Hospital NHS Trust · Imperial College London · CPSSQ

		Information						Contribution							OUTCOME	
#	Site	Point	Hx	X-ray	Path	Psy/soc	Co-morbid	Patient view	Chair	Surg	Phys	Oncolo	Nurse	Radiolo	Histopath	Y/D/N	Free text
1																	
2																	

History	5	Fluent, comprehensive case history.	Psycho-social	5	Comprehensive first-hand knowledge of patients' personal circumstances, social and psychological issues.
	3	Partial case history.		3	Vague first-hand knowledge, or good second-hand knowledge of personal circumstances, social and psychological issues.
	1	No patient case history.		1	No knowledge of personal circumstances, social and psychological issues
x-ray	5	Radiological images.	Co-morbidity	5	Comprehensive first-hand knowledge of patients' past medical history and performance status.
	3	Radiological information from a report/ account.		3	Vague first-hand knowledge, or good second-hand knowledge of past medical history or performance status.
	1	No provision of radiological information.		1	No knowledge of past medical history or performance status.
Pathology	5	Histopathological information explained with slides/pictures.	Patient's views	5	Comprehensive first-hand knowledge of patients' wishes or opinions regarding treatment.
	3	Histopathological information from a report/account.		3	Vague first-hand knowledge, or good second-hand knowledge of patient's wishes or opinions regarding treatment.
	1	No provision of Histopathological information.		1	No knowledge of patient's wishes or opinions regarding treatment.
Chair	5	Good leadership enhanced team discussion and decision making.	Members	5	Clear contribution of speciality.
	3	Leadership neither enhanced nor impeded team discussion and decision making.		3	Contribution inarticulate or vague.
	1	Poor/inadequate leadership impeded team discussion and decision making.		1	No contribution.
Point	Pre Rx	Pre-treatment.	Decision	Y	Clear decision about treatment(s) to be offered.
	Post Rx	Post treatment.		D	Decision to defer to next MDT.
	R	Recurrence/ surveillance.		N	No decision/decision unclear.

FIG. 1 Metric for the observation of decision making used to observe multidisciplinary tumor boards[7]

Analyses

Collected data were tabulated using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA), and all analyses were undertaken using SPSS® version 20.0 software (IBM Corporation, Armonk, NY, USA).

Inter-Assessor Reliability A subset of cases was evaluated independently (also in real time) by a second researcher to assess inter-assessor reliability (see Gwet,[15] Lamb et al.[16], and Arora et al.[17] for inter-assessor reliability within individual MTBs). The cases that were rated by the additional researcher were chosen at random, and researchers were blinded to each other's ratings. Intraclass correlation coefficients (ICCs) ranging between 0 and 1, with higher values indicating better agreement between evaluators, were calculated. A reliability coefficient of 0.70 is considered as a minimum value for team-derived data to be used for research purposes.[22]

Regression Analyses To identify factors that predict the teams' ability to reach treatment recommendation on first case review, we conducted a purposeful selection of variables using univariate logistic regression to identify items for the subsequent multiple logistic regression analysis.[23] Twelve individual variables of MTB-MODe representing the information and contribution quality were included in the regression modeling as predictors (all scored on scales of 1–5) and the teams' ability to reach a decision as a dichotomous outcome variable (scored yes/no). Univariate regression examined the relation of each of the 12 variables individually to the outcome, whereas multiple regression examined the relation of all 12 items to the outcome while controlling for each other. The statistical significance level was adjusted to 0.15 for univariate regression and 0.10 for multiple regression in order to minimize the chances of failing to identify important variables, as well as discrepancy between the two regression methods, as per recommendations for such analyses.[23] Odds ratios in relation to an MTB reaching a decision on first case review are reported. Finally, to clarify any overlap between significant predictors, as revealed by these models, we also conducted partial correlation analyses controlling for tumor type.

RESULTS

Inter-Assessor Reliability

Inter-assessor reliability was analyzed using ICCs on a subset of 273 cases. High reliability was obtained across all tumors: breast, median ICC 0.92 (range 0.27–1.00);

TABLE 1 Univariate logistic regression models predicting treatment recommendation from the items of the MTB-MODe

MTB-MODe items	Unadjusted				Adjusted for tumor type			
	B (SE)	95 % CI for OR		*p*-Value[a]	B (SE)	95 % CI for OR		*p*-Value[a]
		OR	Lower–upper			OR	Lower–upper	
Information								
Comorbidities	0.15 (0.07)	1.16	1.00–1.33	**0.04**	0.15 (0.07)	1.16	1.00–1.33	**0.04**
Psychosocial information	0.35 (0.09)	1.43	1.20–1.69	**0.001**	0.35 (0.09)	1.43	1.20–1.69	**0.001**
Patient history	0.56 (0.09)	1.76	1.47–2.10	**0.001**	0.56 (0.09)	1.76	1.47–2.10	**0.001**
Patient views	0.27 (0.1)	1.31	1.09–1.59	**0.01**	0.29 (0.1)	1.33	1.09–1.59	**0.01**
Radiological information	0.3 (0.05)	1.35	1.21–1.49	**0.001**	0.33 (0.06)	1.40	1.21–1.49	**0.001**
Pathological information	0.37 (0.7)	1.44	1.26–1.69	**0.001**	0.38 (0.72)	1.47	1.26–1.69	**0.001**
Contribution								
Surgeons' input	0.34 (0.05)	1.40	1.29–1.55	**0.001**	0.59 (0.07)	1.81	1.36–1.68	**0.001**
Radiologists' input	0.42 (0.05)	1.51	1.36–1.68	**0.001**	0.39 (0.06)	1.47	1.29–1.55	**0.001**
Pathologists' input	0.28 (0.07)	1.32	1.15–1.52	**0.001**	0.29 (0.07)	1.33	1.15–1.52	**0.001**
Oncologists' input	0.28 (0.06)	1.33	1.17–1.50	**0.001**	0.29 (0.06)	1.33	1.17–1.50	**0.001**
Nurses' input	0.14 (0.06)	1.15	1.01–1.30	**0.03**	0.14 (0.06)	1.15	1.01–1.30	**0.03**
Chairs' input	−0.06 (0.8)	0.95	0.80–1.11	0.50	–0.05 (0.8)	0.95	0.80–1.11	0.52

Bold values are statistically significant

$N = 1045$

B regression coefficient, *SE* standard error, *OR* odds ratio, *CI* confidence interval, *MTB-MODe* Metric for the Observation of Decision-making in Multidisciplinary Tumor Boards

[a] Significance level set to 0.15

TABLE 2 Multiple logistic regression models predicting treatment recommendation from the items of the MTB-MODe

MTB-MODe items	Unadjusted				Adjusted for tumor type			
	B (SE)	95 % CI for OR		*p*-Value[a]	B (SE)	95 % CI for OR		*p*-Value[a]
		OR	Lower–upper			OR	Lower–upper	
Information								
Comorbidities	−0.18 (0.92)	0.84	0.70–1.00	**0.05**	−0.18 (0.09)	0.83	0.70–1.00	**0.06**
Psychosocial information	0.32 (0.10)	1.38	1.12–1.68	**0.01**	0.30 (0.10)	1.35	1.10–1.65	**0.01**
Patient history	0.11 (0.11)	1.12	0.90–1.39	0.31	0.11 (0.11)	1.12	0.90–1.39	0.31
Patient views	−0.03 (0.11)	0.97	0.79–1.20	0.81	0.02 (0.11)	1.02	0.82–1.27	0.87
Radiological information	0.12 (0.09)	1.12	0.94–1.35	0.21	0.08 (0.10)	1.09	0.90–1.31	0.38
Pathological information	0.15 (0.11)	1.16	0.94–1.44	0.16	0.13 (0.11)	1.14	0.93–1.41	0.21
Contribution								
Surgeons' input	0.51 (0.07)	1.66	1.46–1.89	**0.001**	0.48 (0.08)	1.62	1.39–1.88	**0.001**
Radiologists' input	0.47 (0.06)	1.60	1.42–1.81	**0.001**	0.39 (0.09)	1.48	1.23–1.78	**0.001**
Pathologists' input	0.28 (0.08)	1.33	1.15–1.54	**0.001**	0.21 (0.10)	1.23	1.01–1.50	**0.04**
Oncologists' input	0.15 (0.07)	1.16	1.01–1.34	**0.04**	0.12 (0.07)	1.13	0.98–1.31	**0.10**
Nurses' input	−0.16 (0.08)	0.85	0.73–0.99	**0.05**	−0.14 (0.09)	0.87	0.73–1.03	**0.10**
Constant	−1.95 (0.51)	0.14			−1.93 (0.35)	0.15		

Bold values are statistically significant

$N = 1045$; $-2.LL = 671.06$; Nagelkerke $R^2 = 0.27$

B Regression coefficient, *SE* standard error, *OR* odds ratio, *CI* confidence interval, *MTB-MODe* metric for the observation of decision-making in multidisciplinary tumor boards

[a] Significance level set to 0.10

colorectal, median ICC 0.83 (range 0.69–0.96); lung, median ICC 0.86 (range 0.71–0.99); and urological, median ICC 0.71 (range 0.31–0.87).

Regression Analyses

In the univariate analysis, all variables, except chairpersons' input, reached significance (see Table 1) and were therefore entered into the multiple regression model (see Table 2). Table 2 shows that after adjusting for tumor type, positive significant predictors of treatment decisions were patient psychosocial information [Wald (1) = 8.18] and the inputs to case reviews by radiologists [Wald (1) = 17.27], pathologists [Wald (1) = 4.11], surgeons [Wald (1) = 39.48], and oncologists [Wald (1) = 2.64]. Negative significant predictors were patients' comorbidities [Wald (1) = 3.61] and nurses' input [Wald (1 = 2.74]. The remaining variables were not significant. Figure 2 shows the odds ratio of each of these predictors on the probability of making a recommendation for a patient. The inputs of radiologists and surgeons predicted the greatest increase of the odds of reaching a decision, while the nurses' input and patient comorbidity information decreased these odds. To facilitate interpretation, the odds ratios were converted to probability percentages based on the following formula: odds/(odds + 1) × 100 = probability %.[24]

Finally, the partial correlation analyses between significant predictors (as revealed in the multiple regression models) and controlling for tumor type are reported in Table 3. These show that psychosocial information and comorbidities correlate mostly with the nurses' input, thus corroborating the pattern obtained in the multiple regressions. We return to these findings in the "Discussion" section.

DISCUSSION

The findings of this study partially support our hypotheses. Our first hypothesis (H1) was that the ability of MTBs to reach a treatment decision is dependent on the presentation of every type of information. This hypothesis was partially supported; information regarding patients' psychosocial circumstances increased the teams' ability to reach a decision, whereas information on comorbidities reduced it. Our second hypothesis (H2) was that the ability of MTBs to reach decisions is dependent on contributions from each specialty represented at the MTB. We found that the input of surgeons, radiologists, pathologists, and oncologists increased the teams' ability to make a decision, while the input of nurses reduced it. The contribution of the meeting chairperson did not have a significant impact on decision making.

To the best of our knowledge, this is the first study to demonstrate which aspects of MTB meetings are linked to their ability to reach clinical decisions. The finding that all disciplines in MTBs have an impact on decision making is significant and supports the model of a multidisciplinary approach to cancer care. In addition, our findings suggest

FIG. 2 Relationship between the significant predictor variables and probability of making a treatment decision in cancer MTBs. *MTBs* multidisciplinary tumor boards

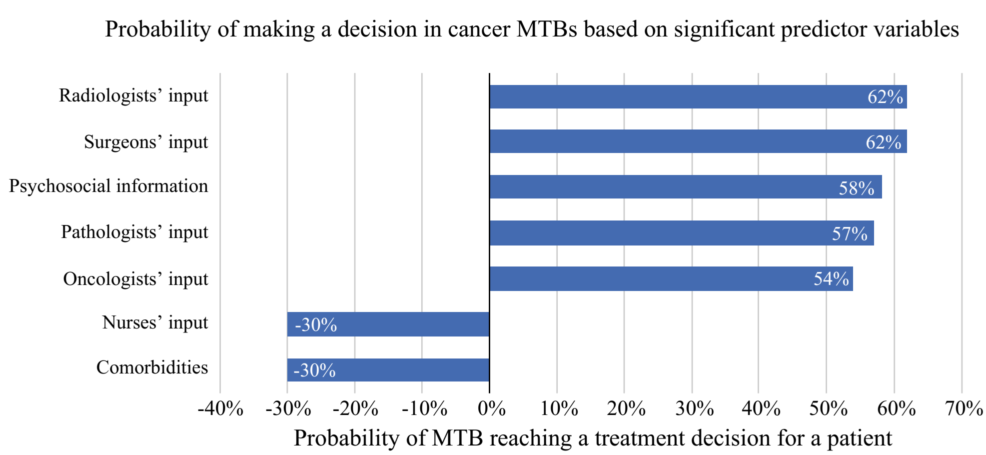


TABLE 3 Partial correlations (controlling for tumor type) between significant predictor variables

	Comorbidities	Nurses' input	Oncologists' input	Radiologists' input	Pathologists' input	Surgeons' input
Psychosocial information	**0.50**	**0.34**	**0.19**	**0.16**	0.03	0.07
Comorbidities		**0.30**	**0.14**	**0.16**	0.06	0.00

Bold values are statistically significant

$N = 1042$; $p < 0.05$. Table entries are Pearson r coefficients that information is necessary, but on its own is insufficient for clinical decision making. Expert review and discussion of this clinical information drives the decision-making process.

A novel and interesting finding of this study is that some elements of the decision-making process influence the ability of the MTB to reach a decision more than others and, more importantly, in different ways. Specifically, nursing inputs and patient comorbidities were found to decrease the probability of reaching a decision, in contrast to every other element. This finding is surprising for a number of reasons. First, there is strong evidence that nurses play an important role within multidisciplinary teams to coordinate care and communicate with patients. Second, nurses are better placed than physicians at obtaining and making sense of information about patients' psychological and social circumstances, as well as their beliefs about and preferences for treatment, information that is positively associated with reaching a decision. Third, previous research has shown that information on patients' comorbidities is important for ensuring that MTB decisions are clinically appropriate, as failure to integrate such information could result in decisions that are, at best, not implementable and, at worst, dangerous.[8,25–27]

One possible explanation for our findings may be that the input of nurses and the integration of information on comorbid conditions are actually indicators of case complexity, which makes decision making harder for a team. Cases where input from nurses about patients' current needs/state of health, as well as information on comorbidities, is important are likely not straightforward. For such cases, the standard management options may not be appropriate and therefore decisions may require further effort by the team. For instance, further discussion with family and relatives may be necessary before a treatment plan is put in place. It may be then that MTBs should redouble their efforts to include such inputs into decision making where cases are complex to ensure that management decisions are appropriate and desirable for patients. Anecdotally, it is generally apparent what constitutes a complex case, although further research is needed to define and quantify complexity and its effect on MTB decision making.

A further possible explanation of these results may be offered by the statistical methods used. It is known that predictor variables can change in the presence of other variables in regression modeling. For instance, in the univariate regression (see Table 1) where each variable is entered into the model on its own, it is apparent that nurses' input and comorbidities have a positive association with MTB decisions. However, this changes when other variables are taken into account in the multiple regression (see Table 2); here, nurses' input and comorbidities change from being positive to being negative predictors. We found that psychosocial information and comorbidities are highly correlated, and in fact they correlated more with nursing rather than with physician inputs. It is thus reasonable to suggest that the presence of psychosocial variables in the multiple regression replaces what is explained by comorbidities in a univariate model; in other words, the psychosocial variable is partially carrying the effect of comorbidities.

While our study shows that patient psychosocial information facilitates MTB decision making, according to patient reports it can be inadequately addressed by healthcare providers and therefore, unsurprisingly, is then underrepresented in MTBs.[7–11] All patients, particularly cancer patients, are faced not only with a physical burden but also with the psychological and social consequence of illness. The psychosocial correlates of a diagnosis of cancer are many, including poor psychological adjustment to cancer, weakened coping abilities, emotional distress, impaired cognition, increased mental illness, limitations in daily activities, pain, fatigue, insufficient material resources and reduced employment, and are related to poor clinical outcomes.[10] This is reflected in guidance by the Institute of Medicine, which lays out a standard of quality cancer care mandating the integration of psychosocial factors into routine cancer care, from diagnosis to survivorship for every patient.[10] Further research is needed to evaluate the quality of decisions against patients' needs and values, and explore how such information can be effectively integrated into MTB decision making in order to further enhance the quality of care provided.

One last finding of interest was the lack of impact of the MTB chairperson. MTB chairpersons have an indirect influence on the team's decision making since their role is to facilitate discussion. When the MTB meeting is functioning well and decisions are being reached, the chairperson may not be required to contribute directly and therefore does not score highly on observational evaluation. If the MTB decision making is not optimal, the chairperson may be required to intervene more often, but the team may still be unable to make decisions. From a measurement point of view, the two patterns may thus cancel each other out. It is arguable that the MTB-MODe does not capture the complex role of the chairperson in enough detail to allow accurate statistical modeling of such complex chairing skills. We are exploring these in prospective investigations aimed at clarifying the role and input of the chairperson, and constructing a more detailed evaluation tool for chairing skills.[28]

Limitations and Generalizability

The participants in our study were aware that they were being observed, hence we cannot rule out observer bias and the Hawthorne effect (namely, teams changing their usual behavior due to being observed). While this is a natural limitation to all observational evaluations, in our study the evaluators were all surgeons, the presence of whom within an MTB is natural. Furthermore, although we have made an attempt to control for the tumor type/center, we acknowledge that the data were derived from different institutions and MTBs, and that team and organizational cultures could have influenced outcomes. This may have confounded institutional versus team- or tumor-specific effects on team decision making. Future work should nonetheless explore a stratified sample of cases across hospitals and tumors, and help gain better understanding of how these differences affect team outcome. Lastly, although this is a large-scale study for its nature (in vivo observations), generalizability of our findings may be limited to the most common cancer MTBs within the English National Health Service (NHS). Replication and assessment of generalizability of the findings to other cancers (especially lower-frequency cancers) and health systems needs to be examined further to determine generalizability.

CONCLUSIONS

Previous research has shown inequality of contribution to case discussions in MTBs, with nurses being underrepresented, and suboptimal information sharing, with more emphasis on biomedical information than patient psychosocial aspects and comorbidities. Our study demonstrates for the first time that the patient psychosocial information and inputs by all core disciplines in MTBs are important since they stimulate the teams' ability to make clinical decisions. Nursing inputs and information on patient comorbidities are associated with difficulty in reaching clinical decisions, suggesting that such cases are complex, and that, for difficult cases, treatment recommendations may not be possible at the point of the team meeting. Building on our findings, further research could investigate (i) what constitutes a complex case for discussion, and (ii) how to better integrate patient psychosocial information into MTB decision making.

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REFERENCES

1. Department of Health. Manual for cancer services. London: The Department of Health; 2004.
2. Mistry M, Parkin DM, Ahmad AS, Sasieni P. Cancer incidence in the UK: projections to the year 2030. *Br J Cancer.* 2011;105:1795–803.
3. World Health Organization. World cancer report 2014. Lyon: International Agency for Research on Cancer, World Health Organization; 2014.
4. NHS England. Everyone counts: planning for patients 2014/2015 to 2018/2019. England: NHS England; 2014.
5. Hong NJ, Wright FC, Gagliardi AR, Paszat LF. Examining the potential relationship between multidisciplinary cancer care and patient survival: an international literature review. *J Surg Oncol.* 2010;102:125–34.
6. Department of Health. National peer review report: cancer services 2012/2013. London: The Department of Health; 2013.
7. Lamb BW, Wong HWL, Vincent C, Green JSA, Sevdalis N. Teamwork and team performance in multidisciplinary cancer teams: development of an observational assessment tool. *BMJ Qual Saf.* 2011;20:849–56.
8. Lamb BW, Brown K, Nagpal K, Vincent C, Green JS, Sevdalis N. Quality of care management decisions by multidisciplinary cancer teams: a systematic review. *Ann Surg Oncol.* 2011;18:2116–25.
9. Stairmands J, Signal L, Sarfati D, Jackson C, Batten L, Holdaway M, et al. Consideration of comorbidity in treatment decision-making in multidisciplinary team meetings: a systematic review. *Ann Oncol.* 2015;26(7):1325–32.
10. Institute of Medicine. Cancer care for the whole patient: meeting psychosocial health needs. Washington, DC: The National Academies Press; 2008.
11. Department of Health. Cancer patient experience survey 2011/2012: national report. London: Crown Copyright; 2012.
12. Raine R, Xanthopoulou P, Wallace I, et. al. Determinants of treatment plan implementation in multidisciplinary team meetings for patients with chronic diseases: a mixed-methods study. *BMJ Qual Saf.* 2014;23:867–76.
13. Lee EO, Emanuel EJ. Shared decision making to improve care and reduce costs. *New Eng J Med.* 2013;368:6–8.
14. Stacey D, Legare F, Col NF, et. al. Decision aids for people facing health treatment or screening decisions. *Cochrane Database Syst Rev.* 2011;(10):CD001431.
15. Gwet KL. Handbook on inter-rater reliability: the definitive guide to measuring the extent of agreement among multiple raters. 3rd ed. Gaithersburg, MD: Advanced Analytics, LLC; 2014.
16. Lamb BW, Green JSA, Benn J, et al. Improving decision making in multidisciplinary tumor boards: prospective longitudinal

evaluation of a multicomponent intervention for 1,421 patients. *J Am Coll Surg.* 2013;217(3):412–20.
17. Arora S, Sevdalis N, Tam C, Kelley C, Babu ED. Systematic evaluation of decision-making in multidisciplinary breast cancer teams: a prospective, cross-sectional study. *Eur J Surg Oncol.* 2012;38(5):459.
18. Shah MS. An evaluation of colorectal cancer multidisciplinary team meetings. PhD [dissertation]. London: Imperial College London; 2015. Available from: Spiral Repository.
19. Gandamihardja T, McInerney S, Soukup T, Sevdalis N. Improving team working within a breast MDT: an observational approach. *Eur J Surg Oncol.* 2014;40(5):604.
20. Jalil R, Akhter W, Lamb BW, Taylor C, Harris J, Green JS, et al. Validation of team performance assessment of multidisciplinary tumor boards. *J Urol.* 2014;192(3):891–98.
21. National Cancer Action Team. The characteristics of an effective multidisciplinary team (MDT). London: National Cancer Action Team; 2010.
22. Hull L, Arora S, Symons NR, et. al. Training faculty in non-technical skill assessment: national guidelines on program requirements. *Ann Surg.* 2013;258(2):370–5.
23. Bursak Z, Gauss HC, Williams DK, Hosmer DW. Purposeful selection of variables in logistic regression. *Source Code Biol Med.* 2008;3:17.
24. Grimes DA, Schulz KF. Making sense of odds and odds ratios. *Obstet Gynaecol.* 2008;111(2 Pt 1):423–6.
25. Lamb BW, Jalil R, Shah S, et. al. Cancer patients' perspectives on multidisciplinary team working: an exploratory focus group study. *J Urol Nurs.* 2014;34(2):83–91.
26. Lamb BW, Allchorne P, Sevdalis N, Vincent C, Green JSA. The role of the cancer nurse specialist in the urology multidisciplinary team meeting. *Int J Urol Nurs.* 2011;5:59–64.
27. Lamb BW, Sevdalis N, Arora S, et al. Teamwork and team decision-making at multidisciplinary cancer conferences: barriers, facilitators, and opportunities for improvement. *World J Surg.* 2011;35:1970–1976.
28. Jalil R, Akhter W, Sevdalis N, Green JSA. Chairing and leadership in cancer MDTs: development and evaluation of an assessment tool. *Eur Urol Suppl.* 2013;12(6):132–3.