BMJ Health & Care Informatics

Effect of digital-enabled multidisciplinary therapy conferences on efficiency and quality of the decision making in prostate cancer care

Erik Ronmark,[1] Ralf Hoffmann,[2] Viktor Skokic,[1,3] Maud de Klerk-Starmans,[2] Fredrik Jaderling,[3] Pieter Vos,[2] Maudy C W Gayet,[2] Hans Hofstraat,[2] Marco Janssen,[2] Olof Akre,[1,3] Per Henrik Vincent [1,3]

To cite: Ronmark E, Hoffmann R, Skokic V, *et al*. Effect of digital-enabled multidisciplinary therapy conferences on efficiency and quality of the decision making in prostate cancer care. *BMJ Health Care Inform* 2022;**29**:e100588. doi:10.1136/bmjhci-2022-100588

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjhci-2022-100588).

Received 25 March 2022
Accepted 12 July 2022

[1]Department of Pelvic Cancer, Karolinska University Hospital, Stockholm, Sweden
[2]Philips Research, Eindhoven, The Netherlands
[3]Department of Molecular Medicine and Surgery, Karolinska Institutet, Stockholm, Sweden

Correspondence to
Dr Per Henrik Vincent; per.vincent@regionstockholm.se

ABSTRACT

Objectives To investigate the impact on efficiency and quality of preprostatectomy multidisciplinary therapy conferences (MDT) at Karolinska University Hospital related to the use of a digital solution compared with standard of care. Further, to explore whether gains in MDT efficiency and quality impact oncological or functional patient outcomes.

Methods We conducted a prospective, observational study of preoperative prostate cancer MDT at Karolinska between February 2017 and March 2021, including 1329 patients. We compared efficiency and quality of the standard MDT and the MDT using the digital solution IntelliSpace Precision Medicine Multidisciplinary Team Orchestrator (ISPM) based on the previously used MDT-MODe approach. Clinical and patient-reported functional outcomes were derived from the medical records and the Swedish National Prostate Cancer Register.

Results While ISPM was used during the MDT meeting, the time spent per patient was reduced by 24% (p<0.001) and most of the MDT-MODe items were scored significantly higher. There was a reduction in pelvic lymph-node dissection procedures in the ISPM cohort (p=0.001) and an increased proportion of unilateral nerve-sparing procedures (p=0.005), while all other outcome-related measures were not significantly different between the two patient groups.

Discussion and conclusion To increase the value of the MDT, all data relevant for treatment decision need to be purposefully presented and compiled, which also enables secondary use of the data.

The use of a digital solution during preoperative MDTs for prostate cancer decision making at Karolinska University Hospital improved the efficiency and quality of this multidisciplinary team meeting without impacting patient outcomes.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Multidisciplinary therapy conferences are widely used in modern cancer care and patients discussed in a multidisciplinary therapy conference are more likely to receive appropriate staging and treatment. However, the multidisciplinary therapy conference is time consuming and rarely digitalised or adequately structured.

WHAT THIS STUDY ADDS

⇒ The use of a digital clinical decision support system during preoperative prostate cancer multidisciplinary therapy conferences improved the efficiency and quality of the meetings but was not associated with changes in oncological and functional outcomes after surgery.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Apart from allowing for more efficient use of clinical resources, digitalisation of multidisciplinary therapy conferences holds a promise to enable truly data-driven clinical workflows.

INTRODUCTION

The multidisciplinary therapy conference (MDT) has become a corner stone of cancer care. Patients who are discussed in an MDT, where a team of hospital staff gather to summarise relevant data and decide on treatment recommendations, are more likely to receive appropriate staging and treatment plans, but it is unclear whether this also results in improved patient outcomes.[1] Among parameters that may affect the value of an MDT, leadership, clarity of objectives, technical equipment for visualisation and electronic documentation, continuous audit of the process, access to complete case information and clarified roles of healthcare professionals have been identified as potentially vital prerequisites for a systematic MDT approach.[2 3]

The MDT often gathers a large number of health professionals, and, with more complex diagnostic and therapeutic options, the quality and efficiency of the decision-making process becomes increasingly important.

MDT conferences are rarely fully digitalised or adequately structured, which may affect the quality and efficiency of the decision-making process.[4] Data are not compiled and presented visually in a structured way and clinical parameters are presented verbally, which may lead to delays in the discussion when information needs to be repeated. Lack of continuous access to the clinical parameters during the MDT session may lead to information loss and hamper the multidisciplinary character of the MDT, thereby increasing the risk of non-optimal treatment decisions.[5 6] Moreover, if the consensus decisions are not captured in the electronic medical records (EMR) in real-time, this may lead to errors, misunderstandings and delay in data transfer to the EMR.

With the field of digital health evolving rapidly, solutions for MDTs have been developed and assessed. Structuring MDTs by use of such solutions has been shown to increase adherence to national guidelines and efficiency in several tumour forms.[7 8]

To increase the MDT efficiency without compromising quality of patient care, multiple quality-assessment tools and discussion checklists have been developed. Whether these tools also positively impact patient outcomes remains unknown.[9] In this study, we hypothesised that use of a digital, patient-centric, diagnosis-specific solution developed jointly by us (IntelliSpace Precision Medicine Multidisciplinary Team Orchestrator, further referred to as 'ISPM' throughout this text) during preprostatectomy MDTs at Karolinska University Hospital would improve the efficiency and quality of the MDT. The primary aim of the study was to investigate whether the use of the ISPM application saved meeting time and improved the quality of the decision process. The secondary aim was to assess whether the oncological and functional patient outcomes were affected by the implementation of ISPM.

METHODS

We have done a prospective observational cohort study comparing patient cohorts before and after the introduction of the clinical decision-support tool ISPM. The study was conducted between February 2017 and March 2021 at Karolinska University Hospital including patients discussed at preprostatectomy MDTs before undergoing robot-assisted radical prostatectomy.

Study setting

Hospital care in Sweden is entirely funded by taxes, and is therefore, as a rule, population based. Karolinska University Hospital is a Swedish tertiary referral hospital treating patients in all risk categories but with emphasis on high-risk patients referred from all regions of Sweden.

The weekly preprostatectomy MDT meeting is attended by 10–12 specialists in urology and radiology and aims to find a surgical strategy for an optimal balance between radical removal of the prostate cancer and postoperative functional outcomes.

Before we introduced ISPM, staff urologists took turns chairing the MDT, verbally reporting the clinical data from printed EMR excerpts, followed by a presentation of the MR images by a radiologist. The staff then discussed the optimal strategy for degree of nerve-sparing surgery, extent of sphincter sparing dissection in the apex, lymph-node dissection or not, degree of radicality in the bladder neck and the seminal vesicles. The concluded surgical treatment strategy plans were documented by the respective chair urologist in the EMR after the conference.

After the introduction of ISPM, all relevant clinical and radiological data were entered in the ISPM platform prior to the MDT meeting. In contrast to the baseline setting, clinical and radiological data were continuously visualised on the ISPM dashboard during the MDT meeting alongside the MR images until the surgery treatment plan had been captured in ISPM using the treatment plan documentation tool of the application (figure 1).

A baseline measurement in the standard MDT setting (before the use of ISPM) was carried out (February 2017–Septmber 2019), and, consecutively, data were collected while ISPM was in use (October 2019–March 2021). The efficiency and quality of the MDTs was compared by timing the discussion and using a modified version of the Metric of Decision-Making (MDT-MODe).[10] Nine items measuring quality were scored using a Likert scale (1, 3 and 5) with higher score indicating higher quality (for details of the modified version of the MDT-MODe used in this study, see online supplemental table 1). We grouped the MDT-MODe items into two main categories: MDT-MODe items relating to the availability and presentation of decision-relevant data, and MDT-MODe items related to the efficiency of MDT execution and team member interaction. Two observers, not participating in the therapy discussion, took turns assigning the MDT-MODe scores. An inter-rater variability analysis was conducted by letting the two observers assign scores to the same MDTs on three separate occasions to ensure agreement.

Software platform

The 'ISPM' software solution enables preparing, scheduling, visualisation, presentation and documentation of information and decisions taken in MDT case discussions. Using SQL queries, the system collects and transforms structured and unstructured data from the hospital data lake into a prostate data model and stores the result into an FHIR database following SNOMED-CT codes. In the study implementation, variables of interest but not available in the research copy of the Karolinska data lake were manually entered in ISPM.

Patient population

In all, 924 patients were discussed at MDTs in the period February 2017–September 2019, before the implementation of the ISPM software ('baseline' cohort), and 405 at conferences between October 2019 and March 2021 using ISPM ('ISPM' cohort). Only patients undergoing prostatectomy as primary treatment for prostate cancer

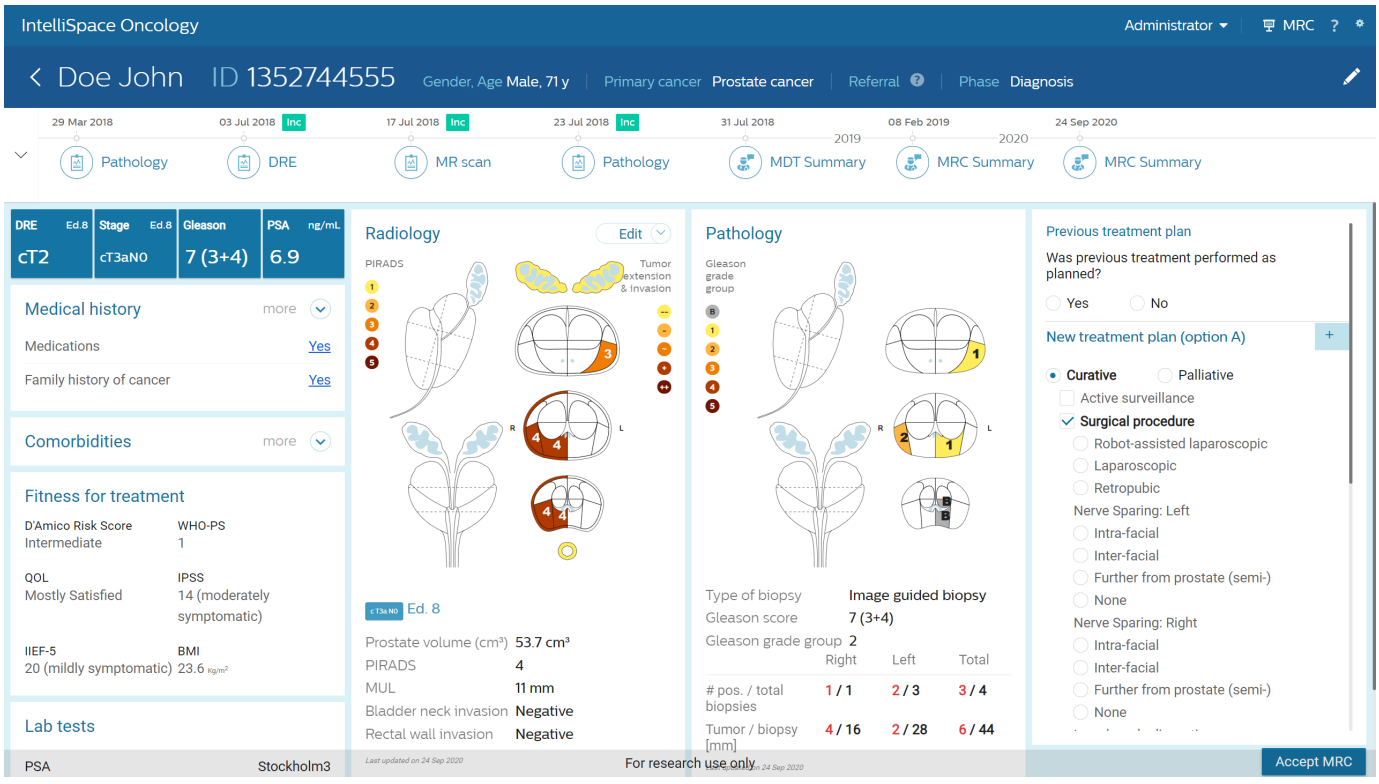

Figure 1 ISPM dashboard as implemented and used in the prospective, observational study on the impact of a digital solution during the MDTs in the prostate cancer care flow at Karolinska University Hospital. Patient data are fictional and do not originate from a real person. BMI, body mass index; IIEF-5, International Index of Erectile Function; MDT, multidisciplinary therapy; ISPM, IntelliSpace Precision Medicine Multidisciplinary Team Orchestrator; MDT, multidisciplinary therapy; QOL, quality of life; PSA, prostate-specific antigen; PIRADS, Prostate Imaging-Reporting & Data System; MRC, magnetic resonance imaging conference.

at Karolinska University Hospital within 30 days after their preoperative conference were included, to increase the likelihood that the conference decision was implemented. We assigned MDT-MODe scores to 164 baseline and 163 ISPM patients, at 21 and 22 MDTs, respectively.

Oncological and functional patient outcomes

All clinical and patient-reported outcome data were obtained from routinely collected clinical or quality follow-up data. Positive surgical margin (as sign of remaining cancer and hence non-radical treatment) was used as a surrogate for oncological quality with significant positive margin defined as at least of three millimetres length. Other relevant post-surgical and perisurgical outcomes, such as extended lymph-node dissection, positive lymph nodes, and nerve-sparing surgery, were also analysed. Functional outcomes were obtained using the questionnaires in the Swedish National Prostate Cancer Register (NPCR) that all prostate cancer patients in Sweden are invited to answer before undergoing primary treatment and twelve months after treatment. The questionnaires are administered in collaboration with the Swedish Regional Cancer Centres and NPCR and can be found at https://npcr.se/eprom/dokument. In this study, we defined urinary continence as 'use of less than one protective urinary pad per day' and urinary incontinence as 'use of one or more protective urinary pad per day'. Erectile function was measured using the International Index of Erectile Function questionnaire (IIEF-5)[11] with erectile dysfunction defined as less than 12 points. Quality of life regarding 'erectile function satisfaction and continence satisfaction' was defined as a self-report of either not bothering the patient at all or only to a small degree. Tumour grade was scored using ISUP grading.[12]

Statistical analysis

In tables 1 and 2 (and online supplemental table 2,3), comparisons of the characteristics of the studied population with respect to the use of ISPM at MDTs were structured according to the following: the distributions of numerical variables or ordinal variables with more than two levels were compared using the Mann-Whitney U test. The distributions of categorical variables with more than two categories were compared using the χ^2 test, whereas the distributions of categorical variables with two categories where one category was identified as the outcome of interest were compared in terms of prevalence ratios and the likelihood ratio test associated with an estimated log-binomial model. Levene's test, centred at the median, was used to assess the difference in variance between non-normally distributed variables.

For figures 2A and 3A–3D, the distributions of ordinal variables were compared using the Mann-Whitney U test. For figure 2B, the association between the usage of ISPM and the duration of discussion for each individual patient at the MDTs was studied using a linear regression model including the number of patients evaluated at a conference, the usage of ISPM and their interaction as explanatory variables.

Table 1 Patient demographics of the baseline versus the ISPM cohort

	Baseline	ISPM	P value
No of patients	n=924 (69.5%)	n=405 (30.5%)	
No of patients in MDT-MODe	n=164 (50.2%)	n=163 (49.8%)	
No of patients per conference	Mean=7.8 (SD=2.9)	Mean=7.4 (SD=2.6)	M-W p=0.74
No of staff per conference	Mean=11.7 (SD=2.7)	Mean=11.5 (SD=2.8)	M-W p=0.85
Patient age (years)	Mean=65.5 (SD=7.4)	Mean=65.9 (SD=7.1)	M-W p=0.48
Postoperative ISUP grade group			M-W p=0.27
ISUP 1	74 (8.3%)	11 (3.1%)	
ISUP 2	424 (47.6%)	181 (51.3%)	
ISUP 3	274 (30.8%)	118 (33.4%)	
ISUP 4	44 (4.9%)	15 (4.2%)	
ISUP 5	74 (8.3%)	28 (7.9%)	
Missing*	34 (3.7%)	52 (12.8%)	
Postoperative T stage (pT)			M-W p=0.34
pT2	535 (59.8%)	215 (61.3%)	
pT3a	258 (28.8%)	111 (31.6%)	
pT3b	100 (11.2%)	25 (7.1%)	
pT4	2 (0.2%)	0 (0%)	
Missing*	29 (3.1%)	54 (13.3%)	
Preoperative incontinence			M-W p=0.008
Continent	296 (96.7%)	289 (99.7%)	
Incontinent	10 (3.3%)	1 (0.3%)	
Missing*	618 (66.9%)	115 (28.4%)	
Preoperative IIEF-5 score			M-W p=0.90
	Mean=14.2 (SD=9.5) (#missing*=618 (66.9%))	Mean=14.4 (SD=9.6) (#missing*=122 (30.1%))	
Preoperative erectile dysfunction - outcome: impotence (IIEF-5 score <12)			LRT p=0.86
Frequencies	133/306 (43.5%) (#missing*=618 (66.9%))	121/283 (42.8%) (#missing*=122 (30.1%))	
Prevalence ratios	1.0 (Ref.)	0.98 (0.81–1.18)	
Response frequency to preoperative questionnaire			χ^2 p<0.00 1
	309 (33.4%)	290 (71.6%)	

*Percentage missing calculated on the entire cohort.
IIEF-5, International Index of Erectile Function questionnaire; ISPM, IntelliSpace Precision Medicine Multidisciplinary Team Orchestrator; ISUP, International Society of Urological Pathology; LRT, likelihood ratio test; MDT, multidisciplinary therapy conference; M-W, Mann-Whitney U test.

All calculations were performed in R V.4.0.0.

We have used the SQUIRE 2.0 (Standards for QUality Improvement Reporting Excellence) guidelines in preparation for this manuscript.[13]

RESULTS

Patient cohorts

The two cohorts (baseline and ISPM) were similar with respect to demographic and clinical characteristics, mean patient age, postoperative ISUP grade group, tumour stage, and erectile function (table 1). The response rate to the NPCR questionnaires measuring preoperative functional status was significantly higher among patients discussed using the ISPM solution, 70.9% vs 32.6% when ISPM was not used (p<0.001). Among those who responded, incontinence was more common in the baseline group, but the difference was small in absolute numbers, 3.4% (10 out of 298 patients) compared with 0.3% (1 out of 287 patients).

Time efficiency of the MDT

The average time spent discussing each patient was 24% shorter in the ISPM compared with the baseline setting (3.8 vs 5.0 min; p<0.001; figure 2A). There was also a significant difference in variances between comparison

Table 2 Oncological, perioperative and 12-month functional (urinary, sexual) patient outcomes of the baseline versus the ISPM patient cohort

	Baseline	ISPM	P value
Positive surgical margin			LRT 0.51
Frequencies	251/906 (27.7%) (#missing=18 (1.9%))	98/378 (25.9%) (#missing=27 (6.7%))	
Prevalence ratios	1.0 (Ref.)	0.94 (0.76–1.14)	
Nerve-sparing—any			M-W=0.11; $\chi 2$=0.13
Any nerve-sparing	805 (88.2%)	353 (91.2%)	
No nerve-sparing	108 (11.8%)	34 (8.8%)	
Missing*	11 (1.2%)	18 (4.4%)	
Nerve-sparing unilaterally or bilaterally—dichotomised, with pairwise comparisons			c^2=0.005 – OVERALL
Bilateral	392 (42.9%)	140 (36.2%)	c^2=0.05†
Unilateral	413 (45.2%)	213 (55.0%)	c^2=0.005†
No nerve-sparing	108 (11.8%)	34 (8.8%)	c^2=0.13†
Missing*	11 (1.2%)	18 (4.4%)	
Pelvic lymph-node dissection			M-W p<0.001
No	543 (60.0%)	248 (70.1%)	
Yes	362 (40.0%)	106 (29.9%)	
Missing*	19 (2.1%)	51 (12.6%)	
Lymph-node metastases among patients that underwent pelvic lymph-node dissection			M-W p=0.92
No (N0)	302 (83.4%)	88 (83.0%)	
Yes (N1)	60 (16.6%)	18 (17.0%)	
Missing*	0 (0%)	0 (0)	
Erectile dysfunction at 12 months after surgery—outcome: impotence (IIEF-5 score <12)			LRT 0.90
Frequencies	451/604 (74.7%) (#missing*=320 (34.6%))	172/229 (75.1%) (#missing*=176 (43.5%))	
Prevalence ratios	1.0 (Ref.)	1.01 (0.92–1.09)	
Incontinence at 12 months after surgery—outcome: incontinence			LRT 0.98
Frequencies	171/619 (27.6%) (#missing*=305 (33.0 %))	64/231 (27.7%) (#missing*=174 (43.0%))	
Prevalence ratios	1.0 (Ref.)	1.0 (0.78–1.27)	

*Percentage missing calculated on the entire cohort.
†Pairwise comparison; Bonferroni-Holm corrected for multiple testing.
IIEF-5, International Index of Erectile Function; ISPM, IntelliSpace Precision Medicine Multidisciplinary Team Orchestrator; LRT, likelihood ratio test; M-W, Mann-Whitney U test.

groups (Levene's test; p<0.001), indicating a more predictive duration per patient when using ISPM. During the baseline period, the time spent discussing each patient decreased with increasing number of cases in the meeting (Pearson correlation=−0.23; p=0.04). During the ISPM period, there was no such significant correlation (Pearson correlation=−0.075; p=0.36; figure 2B).

Quality of the MDT

There were higher MDT-MODe scores for the information presentation items psychosocial, comorbidity (p<0.01) and pathology (p<0.05) during the ISPM period, while there was no difference in the presentation of patient's views, imaging, and patient history (figure 3A). Team interaction items regarding quality of leadership (Chair) and contribution of specialty (Members) also received higher scores in the ISPM setting (p<0.001; figure 3B). Furthermore, the fraction of participants actively taking part in the MDT discussion increased using ISPM (p<0.05; figure 3C). Moreover, we observed that there were significantly fewer questions on already presented data raised in the meeting while ISPM was in use (p<0.01; figure 3D).

Oncological and functional outcomes

There was no statistically significant difference with respect to oncological outcomes between the baseline and the ISPM cohorts. The proportion of men with positive surgical margins was 27.7% in the baseline group and 25.9% in the ISPM group (p=0.66; table 2; online supplemental table 2).

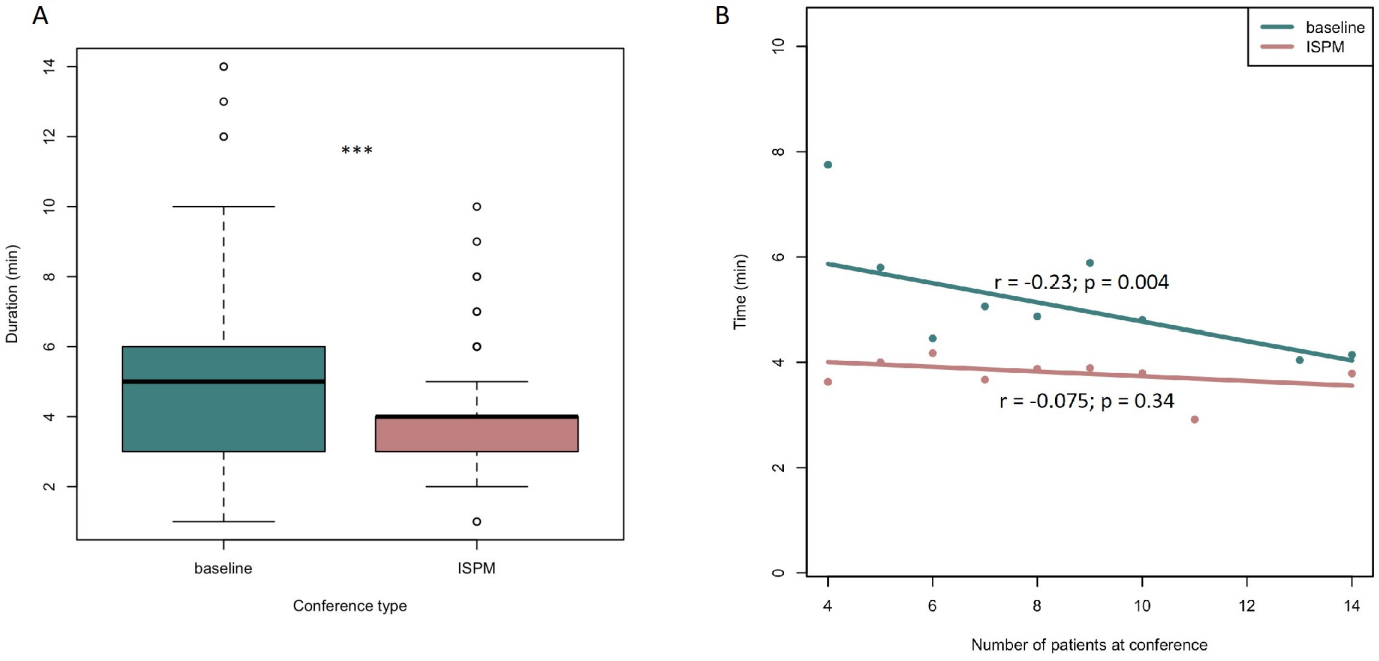

Figure 2 A Time spent in the MDT meeting per patient in the baseline setting (164 patients) versus the ISPM setting (163 patients). Box plot with median and IQR; whiskers denote $\pm 1.5 \times$IQR. ***P<0.001 (B)**:** interaction between mean time (minutes) spent per patient and number of patients scheduled and discussed during the MDT. Dots indicate the mean durations at conferences with a particular number of patients being discussed. Regression lines are derived from 164 (baseline) and 163 (ISPM) patients per group. ISPM, IntelliSpace Precision Medicine Multidisciplinary Team Orchestrator; MDT, multidisciplinary therapy conference.

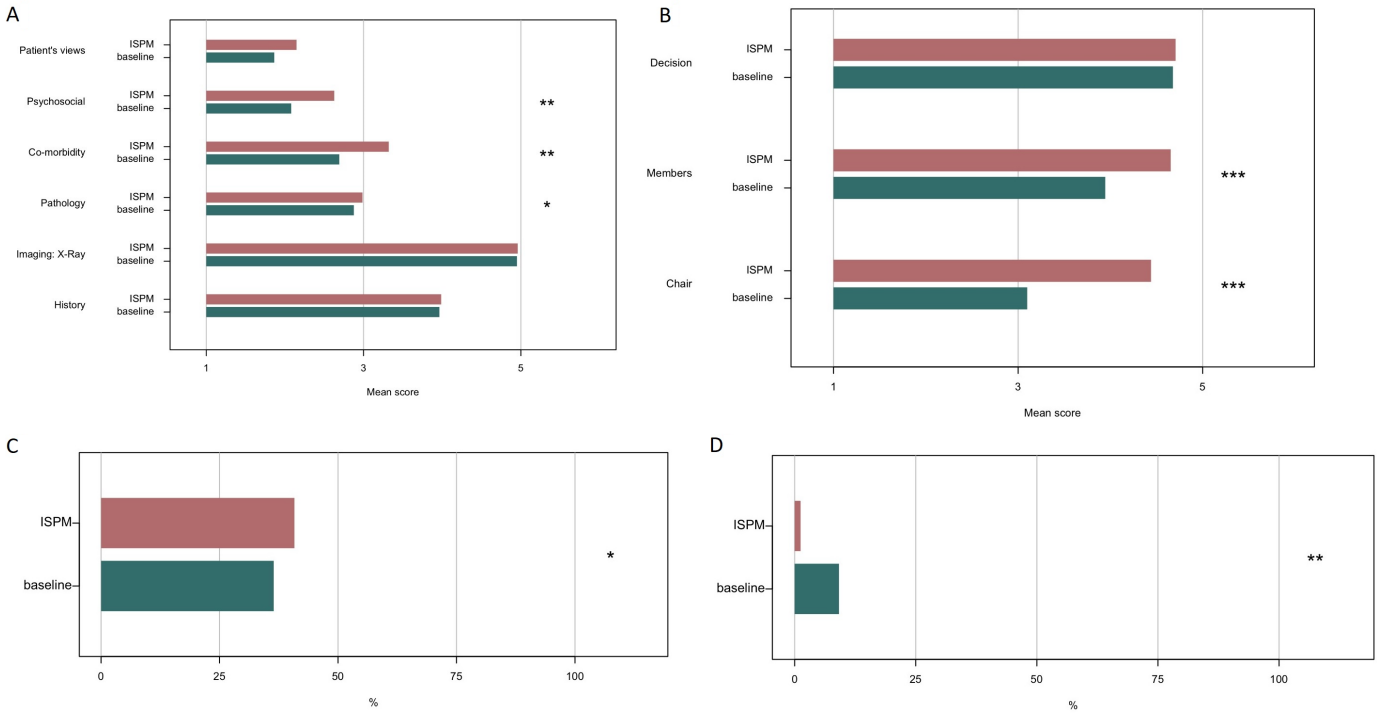

Figure 3 MDT-MODe items concerning information presentation. *P<0.05, **p<0.01. (B) MDT-MODe items concerning leadership and team interaction. ***P<0.001. (C) Percentage of staff members actively participating per patient case discussion and decision making in the MDT. *P<0.05 (D) Percentage of patients for which questions were raised during the MDT meeting to repeat already presented information. **P<0.01. ISPM, IntelliSpace Precision Medicine Multidisciplinary Team Orchestrator; MDT, multidisciplinary therapy conference; MDT-MODe, Metric of Decision-Making.

The overall frequency of nerve-sparing and non-nerve-sparing surgery was virtually similar in the comparison groups, but the patterns differed slightly with more unilateral nerve-sparing surgery in the ISPM group and more bilateral nerve-sparing and non-nerve-sparing in the baseline group (table 2).

An extended pelvic lymph-node dissection was carried out more often in the baseline cohort, 39.1% vs 26.4% for the ISPM cohort, respectively (p=0.001; table 2), but there was no difference in proportion of histologically confirmed metastases (16.6% in the baseline vs 17.0% in the ISPM cohort; p=0.92; table 2).

The functional outcomes 1 year after surgery were similar for the two groups. Erectile dysfunction (IIEF-5 score <12) at 12 months was present among 74.4% (baseline) and 75.1% (ISPM) (p=0.90; table 2) of patients, and incontinence (daily use of one or more urinary pads) was present among 27.6% (baseline) and 27.7% (ISPM) (p=0.98; table 2; online supplemental table 3).

DISCUSSION

We found that implementing ISPM in a multidisciplinary tumour conference was associated with increased efficiency of the conference and less time needed to discuss each patient case. The results also indicated that the variability of the length of each case discussion was reduced with the use of ISPM. At the same time, the quality of the teamwork and the decision-making process was improved with the use of ISPM. These improvements were not, however, reflected in improved oncological or functional patient outcomes.

Using ISPM, discussing one patient took on average 72 s less, which corresponds to a 24% reduction, or approximately 9–10 min shorter MDT in the current setting. Considering that there was a mean of 11.6 participants, more than one person-hour was saved during each session. This time saving is in agreement with results from another group developing a similar oncological clinical decision support system for other cancer types.[8 14]

MDTs are in general scheduled events with a finite duration while the number of patient cases fluctuates and a structured process for the presentation and discussion of each case is paramount for retaining the quality of the decision making throughout the conference. We found both decreased variability of the duration of each case discussion and a consistent duration per case regardless of the number of patients discussed at the conference, indicating that the use of ISPM leads to a more structured and predictable process.

Although the quality of the MDTs increased when ISPM was used, this was not reflected in improved oncological or functional patient outcomes in our data. It should be noted that, already prior to the implementation of ISPM, the format of the preoperative prostate-cancer MDTs at Karolinska had been structuralised—although not into a digital format—with an apparent effect on the nerve-sparing strategy as well as on the risk of positive surgical margins.[15]

While it has been shown that MDTs lead to more accurate staging,[16] higher adherence to clinical guidelines,[17] and shorter time to treatment after diagnosis,[18] several prior studies have failed to show improved outcome among patients discussed in MDT meetings[19–21] while other have reported better outcomes.[22–24] The MDT is a costly process, and it is important that future studies justify the costs through evidence of better outcomes.

A structured digital format for the MDT entails several potential further advantages apart from efficiency and quality in the decision making. For example, the resulting database can be used for real-time quality assessment, feedback to pathologists, radiologists, surgeons and radiotherapists. Also, it enables development of prognostic models for better prediction tailored to the centres' own patient cohorts. Patient-reported outcome measures can be used in the communication with the patient during follow-up for a more structured care of the side effects of treatment and for spending more time with the patient on solving problems rather than understanding them. None of these advantages were assessed in this study but are all strong potential benefits of a digital platform such as ISPM.

Without simultaneous evaluation of positive surgical margins and functional outcomes, quality assessment of prostate cancer surgery is of little use since there is a reciprocal relation between radicality and postoperative function. Digital platforms connecting data points on all dimensions will facilitate more precise quality assessment. Ultimately, applying deep learning to make fuller use of these rich clinical, morphological and patient-reported data is a promising future development.

The main limitation of this study is the observational design with non-concurrent comparison groups. The baseline measurement was carried out over a period of 33 months before the ISPM solution was implemented. Both treatment and outcome of prostate cancer change over time[25] and differences between the baseline and ISPM periods may be attributable to other time-varying factors, such as staff turnover. Furthermore, the lower frequency of pelvic lymph-node dissections in the ISPM period may, apart from a true effect of using the digital platform, be due to subtle changes in our operative indications for the procedure.

Access to patient-reported data is a major clinical need in healthcare in general, but particularly in the care of prostate cancer. The response rate to preoperative questionnaires was low in the baseline group, 32.6% compared with 70.9% the ISPM group. This difference reflects our effort made during the study period to increase patient participation in the national questionnaires on functional outcome rather than an effect of the digital platform.

Conclusion

Our implementation of the ISPM clinical decision support system in MDT sessions at Karolinska University Hospital was associated with more efficient presentations

and decision making in the conference as well as higher perceived quality of the decision process, but not with improved patient outcomes.

Contributors RH, MdK-S, FJ, PV, HH, MJ, OA and PHV conceived the study; RH, PV, OA and PHV wrote the study plan with input from ER, FJ, HH, MJ; ER, RH, MdK-S, FJ, PV, HH, MJ, OA and PHV contributed to the design of the software; ER, VS, FJ, PV, MdK-S, PHV collected the data; ER, VS, PHV performed the statistical analyses with input from RH, MCWG; ER, MCWG drafted the manuscript; all coauthors contributed substantially to the revision of the manuscript and approved the final version; ER and RH contributed equally to this paper; OA is principal investigator of the clinical study and guarantor of the work.

Funding This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 780495.

Competing interests RH, MdK-S, PV, MCWG, HH and MJ are employees of Philips Research, Eindhoven, Netherlands.

Patient consent for publication Not applicable.

Ethics approval The study was approved by the Swedish Ethical Review Authority (Dnr 2018/109-31; 2020-05939).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

ORCID iD
Per Henrik Vincent http://orcid.org/0000-0002-9895-5803

REFERENCES

1 Pillay B, Wootten AC, Crowe H, *et al*. The impact of multidisciplinary team meetings on patient assessment, management and outcomes in oncology settings: a systematic review of the literature. *Cancer Treat Rev* 2016;42:56–72.
2 Raine R, Wallace I, Nic a' Bhaird C. Improving the effectiveness of multidisciplinary team meetings for patients with chronic diseases: a prospective observational study. *Southampton* 2014.
3 Rosell L, Alexandersson N, Hagberg O, *et al*. Benefits, barriers and opinions on multidisciplinary team meetings: a survey in Swedish cancer care. *BMC Health Serv Res* 2018;18:249.
4 Janssen A, Robinson T, Brunner M, *et al*. Multidisciplinary teams and ICT: a qualitative study exploring the use of technology and its impact on multidisciplinary team meetings. *BMC Health Serv Res* 2018;18:444.
5 Horlait M, Baes S, Dhaene S, *et al*. How multidisciplinary are multidisciplinary team meetings in cancer care? an observational study in oncology departments in Flanders, Belgium. *J Multidiscip Healthc* 2019;12:159–67.
6 Soukup T, Murtagh G, Lamb B, *et al*. Degrees of Multidisciplinarity underpinning care planning for patients with cancer in Weekly multidisciplinary team meetings: conversation analysis. *J Multidiscip Healthc* 2021;14:411–24.
7 Farrugia DJ, Fischer TD, Delitto D, *et al*. Improved breast cancer care quality metrics after implementation of a standardized tumor board documentation template. *J Oncol Pract* 2015;11:421–3.
8 Hammer RD, Fowler D, Sheets LR, *et al*. A digital tumor board solution impacts case discussion time and postponement of cases in tumor boards. *Health Technol* 2021;11:525–33.
9 Brown GTF, Bekker HL, Young AL. Quality and efficacy of multidisciplinary team (MDT) quality assessment tools and discussion checklists: a systematic review.. *BMC Cancer,* 2021.
10 Lamb BW, Wong HWL, Vincent C, *et al*. Teamwork and team performance in multidisciplinary cancer teams: development and evaluation of an observational assessment tool. *BMJ Qual Saf* 2011;20:849–56.
11 Rosen RC, Cappelleri JC, Smith MD, *et al*. Development and evaluation of an abridged, 5-item version of the International index of erectile function (IIEF-5) as a diagnostic tool for erectile dysfunction. *Int J Impot Res* 1999;11:319–26.
12 Epstein JI, Egevad L, Amin MB, *et al*. The 2014 International Society of urological pathology (ISUP) consensus conference on Gleason grading of prostatic carcinoma: definition of grading patterns and proposal for a new grading system. *Am J Surg Pathol* 2016;40:244–52.
13 Ogrinc G, Mooney SE, Estrada C, *et al*. The Squire (standards for quality improvement reporting excellence) guidelines for quality improvement reporting: explanation and elaboration. *Qual Saf Health Care* 2008;17 Suppl 1:i13–32.
14 Krupinski EA, Comas M, Gallego LG, *et al*. A new software platform to improve multidisciplinary tumor board Workflows and user satisfaction: a pilot study. *J Pathol Inform* 2018;9:26.
15 Jäderling F, Akre O, Aly M, *et al*. Preoperative staging using magnetic resonance imaging and risk of positive surgical margins after prostate-cancer surgery. *Prostate Cancer Prostatic Dis* 2019;22:391–8.
16 Sundi D, Cohen JE, Cole AP, *et al*. Establishment of a new prostate cancer multidisciplinary clinic: format and initial experience. *Prostate* 2015;75:191–9.
17 Korman H, Lanni T, Shah C, *et al*. Impact of a prostate multidisciplinary clinic program on patient treatment decisions and on adherence to NCCN guidelines: the William Beaumont Hospital experience. *Am J Clin Oncol* 2013;36:121–5.
18 Yopp AC, Mansour JC, Beg MS, *et al*. Establishment of a multidisciplinary hepatocellular carcinoma clinic is associated with improved clinical outcome. *Ann Surg Oncol* 2014;21:1287–95.
19 Boxer MM, Vinod SK, Shafiq J, *et al*. Do multidisciplinary team meetings make a difference in the management of lung cancer? *Cancer* 2011;117:5112–20.
20 Swellengrebel HAM, Peters EG, Cats A, *et al*. Multidisciplinary discussion and management of rectal cancer: a population-based study. *World J Surg* 2011;35:2125–33.
21 Wille-Jørgensen P, Sparre P, Glenthøj A, *et al*. Result of the implementation of multidisciplinary teams in rectal cancer. *Colorectal Dis* 2013;15:410–3.
22 Kočo L, Weekenstroo HHA, Lambregts DMJ, *et al*. The effects of multidisciplinary team meetings on clinical practice for colorectal, lung, prostate and breast cancer: a systematic review. *Cancers* 2021;13. doi:10.3390/cancers13164159. [Epub ahead of print: 18 08 2021].
23 MacDermid E, Hooton G, MacDonald M, *et al*. Improving patient survival with the colorectal cancer multi-disciplinary team. *Colorectal Dis* 2009;11:291–5.
24 Palmer G, Martling A, Cedermark B, *et al*. Preoperative tumour staging with multidisciplinary team assessment improves the outcome in locally advanced primary rectal cancer. *Colorectal Dis* 2011;13:1361–9.
25 Orrason AW, Westerberg M, Garmo H, *et al*. Changes in treatment and mortality in men with locally advanced prostate cancer between 2000 and 2016: a nationwide, population-based study in Sweden. *BJU Int* 2020;126:142–51.