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Report WP8 Task 3

Multidisciplinary teams (MDTs) and the potential impact of new technologies and systems for improving integrated cancer care

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Abbreviations

AI	Artificial intelligence
CDDS	Clinical decision-support systems (CDDS)
ECCO	European CanCer Organisation
EHR	Electronic health record
HIS	Health information system
ICT	Information and communication technologies
ICO	Catalan Institute of Oncology
iPAAC	Innovative Partnership for Action Against Cancer
JA	Joint Action
MDT	Multidisciplinary team
MTM	Multidisciplinary team meeting
NGS	Next generation sequencing
PACS	Picture archiving and communication system
PROM	Patient-reported outcome measure
WP	Work Package

Executive summary

The adoption of information and communication technologies (ICT) is becoming a tangible reality for multidisciplinary teams (MDTs), especially in the decision-making processes undertaken during multidisciplinary team meetings (MTMs). These meetings have become more commonplace and centrally important as cancer care has become more complex and patients more numerous. Health systems have increasingly recognised MDTs as a core element for high-quality care, heightening the need for their efficient and effective functioning. At the same time, the last decade has seen a boom in ICT innovations that complement or directly substitute some of the processes tied to MDT activities, becoming an important factor in generating opportunities that favour integrated cancer care.

This study aims to assess the impact of ICT and health information systems (HIS) on daily MDT tasks and to characterise their limitations and the new challenges posed by their adoption. It takes place within iPAAC Work Package 8, 'Challenges in cancer care', and is based on the perspectives of key informants. Participants were selected through the European CanCer Organisation (ECCO) and in collaboration with different European scientific societies according to study criteria. The sample was multidisciplinary and included professionals from different European healthcare systems with experience in the adoption of ICT tools.

The study identified 10 instruments or functionalities (Fig. 1, p. 9) that were related to MDT activities and MTMs and that entailed the (real or potential) use of ICT/HIS, with implications for transforming the way professionals obtain information, communicate and make decisions. These instruments were categorised into four typologies according to their function: (A) information; (B) management; (C) decision-making and quality assessment; and (D) virtual MTMs.

The study results indicate that ICTs are playing a key role in opening MTMs to other professionals and institutions (by means of virtual meetings) as well as to patients through data registries that have an impact on these processes in real time (e.g. patient-reported outcome measures, or PROMs). In a more limited way, these technologies also enable the use of operating systems that facilitate informational and decision-making processes (e.g. real-world data with the use of clinical decision-support systems). ICT also contributes to increasing the internal efficiency of the teams, for example, through electronic agendas to draw up patient lists or through structured presentation of cases. In any case, ICT adoption is uneven among different health systems and teams.

Although good practices exist for achieving the integration of ICT in team-based decision-making, numerous obstacles and conditions limit its role in MDT tasks. The problems of interoperability of computer systems, both within and between hospitals, is a clear example, as is the resistance of some professionals against, for instance, properly using electronic health records (EHRs). However, the biggest challenge is probably the fact that hospital information systems are structured around repositories and even in computer sub-systems that are not interoperable rather than around care processes. Together, the existence of HIS and EHRs that

were not designed with functionality in mind, plus the massive generation of unstructured data (namely free text pdfs) represent the clearest expression of the large gap between technological development and MDT organisation.

Despite these difficulties, the use of ICT is gradually advancing, and the good practices and progress made to date support its positive impact on improving the efficiency and effectiveness of informational and decision-making processes at the centre of MDTs. These technologies not only have a direct impact on such processes (e.g. virtual MTMs), they also indirectly act as a driver facilitating the integration of other functionalities, like access to molecular information or PROMs, with the potential to transform the teams. On the whole, the impact of ICTs and hospital information systems mark a second transition in the process of MDT development. Digital, dynamic interaction between team members and the ecosystem in which they work (no longer limited to the hospital) will continue to steadily transform the MDT away from the model of one that makes decisions from within an isolated room.

Introduction

The adoption of what is generally known as information and communication technologies (ICTs)[1] is generally modest and uneven between different European health systems, and unsuccessful experiences are not unheard of. Associated challenges include interoperability between information systems and differences between clinical databases, professional skills and available technology among providers. However, ICTs and health information systems (HIS) can be important in generating opportunities that favour integrated cancer care within the context of multidisciplinary teams (MDTs).

Indeed, ICTs and HIS can help cancer MDTs during informational and decision-making processes, allowing teams to use their time more efficiently, obtain the information they need, or enhance their communication. With these ultimate goals in mind, Work Package (WP) 8 of the Joint Action Innovative Partnership for Action Against Cancer (iPAAC) aimed to identify the applications, barriers, facilitators and good practices of ICTs in the context of MDTs and cancer care management (Objective 2, task 3).

This study builds on the work from the previous EPAAC and CanCon Joint Actions, whose results led to the development of landmark documents for multidisciplinary care, for example the 'Policy statement on multidisciplinary care'.[2] The present task is co-organised between the WP8 leaders at the Catalan Institute of Oncology (ICO) and the European CanCer Organisation (ECCO).

The authors of this report are cognizant of the pronounced organisational and financial differences between different European health systems, particularly with relation to MDT objectives, composition, and scope. At the same time, it is also true that all MDTs are characterised by the central role of the tumour board or multidisciplinary team meeting (MTM) as the main decision-making body. Thus, this report focuses on analysing the role of ICT in the areas of information, management, and decision-making in MTMs. European reference networks (ERNs) for rare disease represent one practical model demonstrating the transformations in this sphere, as their approach to sharing information and making decisions is fully reliant on ICTs.[3] The coordination between teams is through virtual MTMs using specific software and following defined criteria for exchanging information, enabling discussion about patients and even their referral.

The present report is based on the perspective of key informants. It aims to assess the impact of ICTs/HIS on the daily work of MDTs and to characterise their limitations and the new challenges posed by their adoption.

Materials and methods

A qualitative study, in two phases and using two data collection methods, was designed to answer the research questions. First, a workshop was held with key informants; following the analysis of the resulting data, interviews were then conducted to contrast and add depth to the information generated.

The first sub-study was the workshop with key informants, who were selected by the European CanCer Organisation (ECCO) and different European scientific societies. The sampling strategy was purposive, with key informants being recruited in accordance with four criteria: (1) professionals working in multidisciplinary environments, (2) experienced in leading and/or adopting the implementation of ICT/HIS, and (3) belonging to different specialties and (4) different European healthcare systems. The meeting took place on 5 July 2019 in a neutral setting (ECCO headquarters in Brussels), and it lasted approximately 5 hours.

Of the initially envisaged eight participants, six professionals from different European scientific societies and organisations were finally enrolled (table 1). The workshop opened with presentations from each professional on the topic, which served to spark reflections on different experiences and perspectives. A focus group was then held to discuss a list of issues related to informational and clinical decision-making processes in cancer MDTs, namely: data collection and accessibility, systems integration, use of electronic health records, and teleconferencing. Topics related to patient communication were excluded.

Focus group discussions allow researchers to utilise group interactions to explore patients' personal experiences and knowledge of a certain topic, and they are ideal for capturing opinions and normative systems.[4] Two researchers conducted the meeting, with one acting as moderator (JP) and the other as an observer (CC). A sheet containing information about the study goals and a consent form were handed out before starting. Spontaneous interaction was encouraged. The session was recorded as well as transcribed verbatim. One researcher (JP) checked for consistency between the recording and text and conducted the posterior analysis. Some quotations from the session are used anonymously in the present report.

This workshop produced critical information for developing the report, but it also served as the basis for an interview guide used in the second sub-study, which consisted of one-on-one semi-structured interviews in other key informants, used to contrast and provide deeper insight into the issues discussed. The organisations involved in this second stage are presented in table 1. The complete list of key informants appears in Annex 1.

To analyse the data, we applied thematic analysis criteria, which emphasise the meaning of the text and interpret its thematic content.[5,6] After checking for information saturation, we read through the transcript to identify general themes and specific categories within the themes, ensuring interpreter consensus. A systematic process of data-treatment analysis was facilitated by the use of the Atlas-ti 6.2 software programme,[7] which allowed for indexing all

the data in textual form and identifying co-occurring codes; however, we limited its use in rearranging the data and forming charts as well as in finding associations among themes. Preliminary results were discussed with the team researchers.

Table 1. Organisations involved in task 3 of WP8

Workshop
European Society of Radiology (ESR)
European Association of Nuclear Medicine (EANM)
European Oncology Nursing Society (EONS)
European Society of Oncology Pharmacy (ESOP)
International Society of Geriatric Oncology (SIOG)
Organisation of European Cancer Institutes (OECI)
Semi-structured interviews
European SocieTy for Radiotherapy & Oncology (ESTRO)
European Society of Medical Oncology (ESMO)
European Society of Gynaecological Oncology (ESGO)

Results

> *"Considering the impact of ICTs on MDTs, the old times were just sitting next to each other, discussing the files, looking at the images, and someone moderating the session."*

The ICTs or HIS identified are classified into four categories according to the type of instrument they are or the function they serve in relation to MTMs (Fig. 1):

(a) Instruments for providing information to MTMs

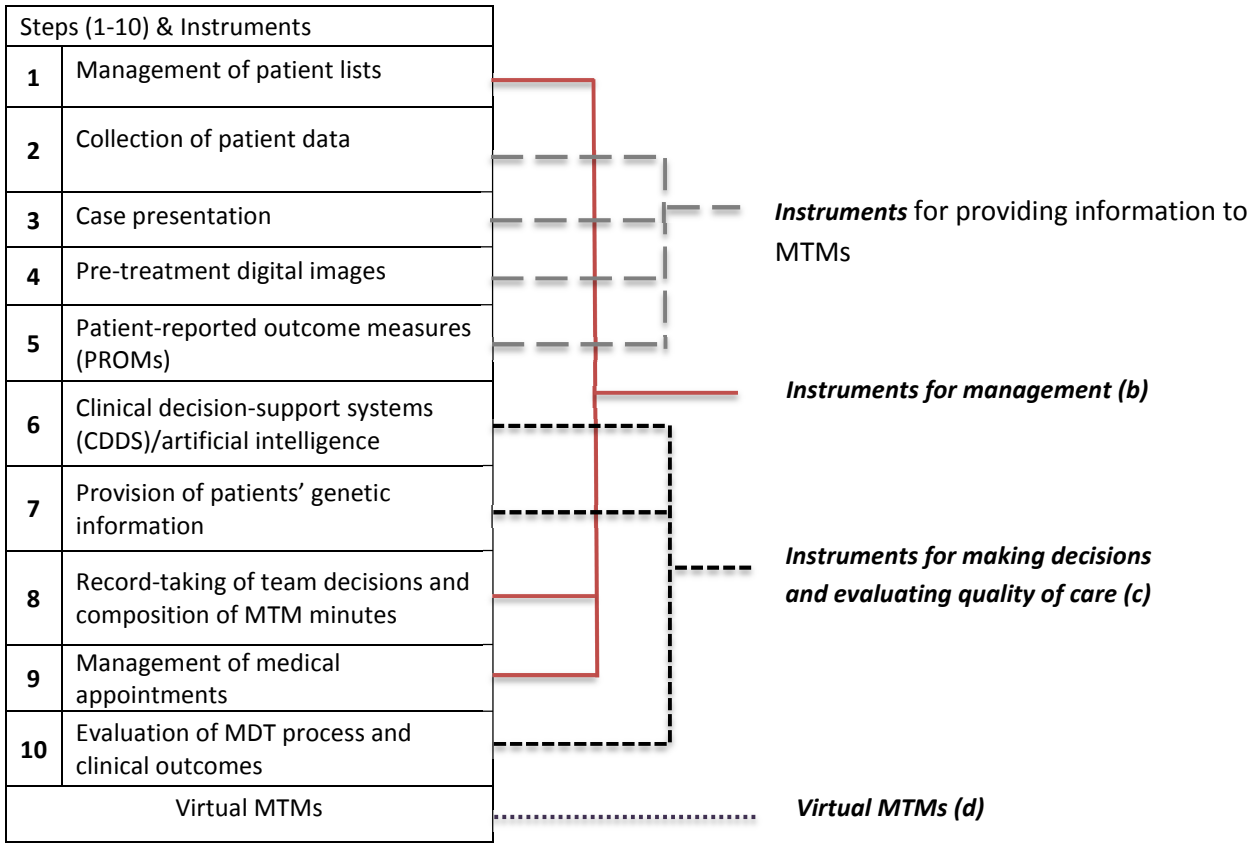
(b) Instruments for management

(c) Instruments for making decisions and evaluating quality of care

(d) Virtual MTMs

Some instruments are primarily used for management; others for providing information to team members about cases under discussion; and others still for making decisions on tumour boards or evaluating quality, with the assumption that clinical practice indicators like the number of patients who die with high toxicity have an impact on decision-making. These categories are not independent or hierarchical, and some overlaps are possible. As virtual MTMs involve many of the instruments, these were examined specifically and in more depth.

Figure 1. ICT/HIS instruments or functions deployed during the informational and decision-making processes in MTMs.



A. Instruments for providing information to MTM participants

Collection of patient data - Instrument 2 *(see figure 1)*

Access to relevant information about cases under discussion in the MTM is essential for agile decision-making. Currently, the informational processes used by many MDTs are negatively affected by the structures of their hospitals' health information systems (HIS). Although some HIS approximate what could be called an integrated information environment, hospital HIS are generally not structured around patient care processes, but rather around the inputs from different functions of each clinical service (e.g. analysis of anatomical pathology, radiological reports), without integration by patient or process. This organisational model means that data collection is performed through independent repositories from which different inputs are extracted in order to draw up a summary of a patient's case and discuss it in the MTM.

This is a situation that contrasts with the cross-sectional nature of MDT work. These teams represent care processes in and of themselves (e.g. patients with colon cancer), not just a single specialty, service, or care episode. In this context, even though EHRs serve as a link between different information sources, they do not arrange all of the elements relevant to a patient's diagnosis and treatment in a specific and integrated way. Indeed, EHRs were not necessarily conceived as a working tool, but rather as an instrument to store and classify information. For the most part, EHRs do not automatically extract or generate the information that professionals need to make decisions in the MTM. However, professionals differ in how they do or do not consult EHRs during the MTM.

> *"The EHR is an evolution from paper, but it is not an integrated information environment."*

> *"In my hospital there are a lot of systems, like monitoring patients at home, but quite often systems don't talk to each other in the same hospital. For example, intensive care has a whole different system. So, we can't see what patients have behind if they come to intensive care. For instance, MDT decisions. You don't see the data, you see the summary."*

To illustrate the situation of fragmented information in repositories and even in computer sub-systems that are not interoperable, oncology pharmacists point to the difficulty of improving patient assessment during the care process when they are not able to easily access information on all of the patient's prescriptions.

> *"If you don't have a complete EHR, you don't know the whole set of medical therapies that the patient received. This impedes the pharmacotherapy analysis by the oncology pharmacist."*

However, the fact that the computer systems or sub-systems are not connected is only part of the problem – the other part is that much of the information is in a free-text pdf format, which is difficult to code. Thus, information is not recorded through a single computer system from which it can be extracted or modified in a structured way. According to our informants, the

reality today is that the medical information to be found within the different computer subsystems is predominantly physician-dependent and captured in a pdf.

> *"We're slaves to pdfs. We live in the era of medical information in pdf format. The problem is always finding it and not being able to use it."*

On the other hand, when the information recorded is well structured within the HIS, data collection can be automated and easily accessed from within an MTM (e.g. as done in breast cancer within the Catalan Institute of Oncology, ICO, Spain).

Another challenge that professionals face – and which may represent the biggest waste of time – is obtaining information for patients referred from other hospitals. Interhospital information processes are not usually standardised, so frequently the information about referrals is incomplete and the images are low-resolution, which may prompt the need for repeating tests. In specialties like nuclear medicine, this repetition is problematic because it can be harmful to patients' health. The good experiences in this field also concern different hospitals that agree to use a common HIS and therefore the same EHRs for patients. This is the case, for instance, in a partnership in Belgium (KWS EPR software developed by nexuzhealth, a joint venture between UZ Leuven and Cegeka[8]). Patient migration in this context does not imply any special obstacles.

> *"We often call services from other hospitals to gather information."*

> *"For some CT scans, we cannot radiate the patient again, so we go all the way to retrieve this information, calling the centres, etc. We do not repeat exams for this reason."*

> *"Having all the relevant images in the same system takes a lot of time. And it's a shame, because we could be investing that time in analysing the images."*

The lack of integration between systems and the time that doctors, nurses, and even physicists have to spend collecting and potentially using the information illustrates the value of the data manager, a figure that most informants saw as being particularly important. This role can be crucial before and after an MTM in order to access, organise, and facilitate the use of valuable data while also identifying unnecessary data. Data managers are also valuable because they can improve the team's self-assessment and learning processes – goals that European healthcare systems are increasingly pursuing. In this line, informants signal that the updated EUSOMA quality indicators in breast cancer care (2017) indicate the need to have a data manager.[9] However, one key informant highlighted that for some cancer centres data managers are only associated with research purposes and, instead, it is the "care manager" (a nurse) the role in charge of managing MDT data apart from other functions such as communicating decisions to the patient or booking appointments.

The window of opportunity in this area of clinical management has been used by some companies to develop software platforms that are implemented as a layer of hospital HIS (e.g. Navify, created by Roche or 360 Oncology, by Varian). These platforms aim, among other things, to capture and integrate all the patient data in the HIS so that when they need to be

discussed in the MTM, the participants already have all the information related to the patient. "Home-made" web-based platforms have been also developed and used by MDTs to standardise patient data collection, as it is the experience of Gemelli University Hospital (Rome, Italy).

Case presentation - Instrument 3

The way cases are described in an MTM varies according to the professional presenting the patient as well as among different MTMs. Some use templates or checklists, while in others the mode of presentation depends on each professional or is assumed by junior doctors. ICTs can have potential impacts by changing the form of presentation if the data records are electronically structured, and it disrupts the logic of independent repositories. An integrated information environment allows visualisation of all the available information during the MTM, so that the professional can directly narrate what's shown on screen, not what is summarised in the medical chart.

The decision to structure the clinical data, and the phasing out of the free-text pdf model that professionals use, is beyond the scope of this report. However, it is worth considering the opinions of the key informants on this topic. On the one hand, there are dangers in structuring MTMs around rigid checklists according to computerised categories, as this limits the individualisation and open discussion of every patient. Some might argue that the loss of that interaction could even preclude the need for a face-to-face meeting among professionals. On the other hand, the benefits of a structured case presentation are undeniable for their capacity to improve the efficiency of MTMs and for the comprehensiveness and rigor that they ensure. For example, data on the patient's psychosocial or geriatric situation are more likely to be discussed when these aspects are part of an information agenda, so they do not depend on the participation of the professionals involved. Finding a balance between a linear and open discussion is critical for increasing MTMs' efficiency without undermining their capacity to adjust decisions.

> *"We use a template, a structured framework, since junior doctors are in charge of case presentation."*

> *"Great treatment decisions are made, but quite often without information on patients' frailty to adjust decisions or prepare the patient."*

Pre-treatment digital images - Instrument 4

New medical technologies apart from ICTs have had a significant impact on the medical imaging world and in the specialties of pathological anatomy, radiology, and nuclear medicine, with benefits for MTMs. To begin with, it is worth pointing out the functionality of the PACS workstation (for **p**icture **a**rchiving and **c**ommunication **s**ystem). In addition to its importance as an element of digitalisation, the PACS station can be used with a simple software programme

to allow MTM participants to visualise the images that they contain directly on the projector or screen used in the meeting, facilitating the presentation of images and contributing to synchronising the MDT's work. Nevertheless, according to a survey by the European Society of Radiology (ESR), just 44% of the PACS in Europe are connected to a video projector.

That report also affirms that only 32% of MDTs have a high-resolution monitor connected to the PACS system. But, according to one informant, "*a high-resolution screen is not necessary because the radiologists have already checked the image before the discussion*". Another specifies, "*in the meeting you don't need high resolution, because the images are used above all to help explain what the image means to treatment specialists"*. On the other hand, PACS also has limitations in nuclear medicine, as *"the images that are available in the PACS system are not ideal for interpreting the nuclear medicine images."*

> *"Sometimes we have to say 'I'll give you advice the next day' and check again at my dedicated work station'."*

Regarding how images are technologically projected in MTMs, there are three different ways: a laptop computer, screens (of different sizes), or a projector. From the informants' perspective, the last of these options is the best for discussing cases, as projectors tend to be larger than screens and can be adjusted, that is, MTM members are not required to stay in the same position in the room as occurs with screens.

Another aspect discussed is the fact that most radiology reports are in free-text form. Again, this limits the use of the data and complicates its access in case it is needed. One informant pointed out that *"an important number of patients are not reviewed by the radiologist in charge before the MTMs"*. While this lack of time is rooted in different causes, a common one is related to important interoperability problems between hospital HIS, which entail problems in access to tests for patients coming from other hospitals. It is not uncommon for patients to arrive with low-quality images, with images that do not meet their clinical requirements, or with CD-ROMs, etc. The lack of standardisation in the exchange of images results in important delays in decision-making.

> *"We're not happy to see the images online. We really need to download the images in our system and review them properly."*

> *"For haematology, when we ask for whole body PET but some centres just forget and send it partially. And then you have to repeat tests."*

Patient-Reported Outcome Measures (PROMs) - Instrument 5

The objectives of this report do not include understanding how ICTs allow patients to interact with each other and with health professionals in order to increase their level of information through mobile applications (apps like Cankado, for taking medication), data exchange platforms, or the like. However, some patients may have a direct presence in the MTM through the collection of PROMs. The informants perceived that PROMs (e.g. a symptom

questionnaire) can help to improve decision-making in MTMs by offering real-time data for discussion. According to one informant, a clear example of this occurs when the uterus must be removed due to an endometrial cancer and on arriving to the operating theatre, the patient is found to be oedematous and the intervention cancelled. Another example emphasised in the literature is that reported by Sundberg et al (2015) in prostate cancer.[10]

Among the benefits attributed to the use of PROMs, their use can reduce delays and re-discussions because the MDT has real-time knowledge of whether a patient has experienced an adverse effect (for example, through an alert system). Furthermore, introducing the patient perspective into the decision-making process using structured informational inputs can improve the appropriateness of the decisions made, while also contributing to keeping the patient engaged throughout their cancer care journey. That said, some caution is warranted in light of the numerous medical apps that are appearing.

> *"The PROMs will be important in the future to make decisions in MTMs. With PROMS the patient is involved in the decision-making process. His/her data is there. It is real time data."*

> "*The digital oncology platform for patients may be used for recording relevant data for us. If a patient types that he or she has fever, automatically a notification is sent to the healthcare providers involved."*

> *"What already exist are some apps that connect patient data with physicians in case of complications."*

> *"The level of patient information should be integrated in the tumour board."*

B. Instruments for management

Management of patient lists - Instrument 1

Control of the list of patients to be discussed in the MTM generally falls on the coordinator of the meeting. The extent to which access to the list is automated varies, although two general situations can be observed:

- ✓ *High degree of automation*: the professionals wishing to discuss a case on a tumour board reserve a time slot for a consultation using the hospital HIS, in the same way they would do for an appointment with any other hospital service. Other professionals can see the list of patients to discuss in real time and then prepare for the meeting accordingly. The moderator downloads the list and takes it to the MTM. This system is particularly beneficial for diagnostic specialists, who can prepare all of the images ahead of time or – in some cases – remove patients with pending test results from the list. Such a system can

also include primary care physicians: provided their systems are interoperable, GPs can receive an electronic invitation letting them know that one of their patients will be discussed (e.g. experience in UZ Gent).

- ✓ *Low degree of automation*: the list of patients to discuss is totally physician-dependent, in that no computer system is used to modify the list. Typically, the coordinator collects and collates team members' proposals and then distributes them in the form of a medical chart containing the clinical description of each patient.

A multidisciplinary electronic patient agenda is one functionality that permits better anticipation and rapid management of the cases to discuss. However, the fact that this is an open-access system can generate problems related to a lack of control over the number of patients to be discussed and the priority afforded to each. Such debates are beyond the scope of this report; however, in light of MTMs' central role in the cancer care process and the increasing incidence of malignancies, there are evident management challenges involved in guaranteeing a reasonable time period to discuss cases whose clinical complexity justifies multidisciplinary deliberation.

The potential for hospital HIS to assume a larger role in formulating patient lists and increasing the efficiency of the informational processes undertaken by teams can be synthesised in three areas:

(1) Improving the internal efficiency of the tumour board by stratifying patients into high and low priority cases in the discussion, according to pre-established criteria agreed on by the team. This way, the MDT can distinguish between cases that should be discussed in depth and those that require less intense collaboration (e.g. confirmation that the treatment strategy is in line with the clinical practice guideline or protocol).

(2) Organising the discussion process, allowing the professionals that only need to weigh in on a few cases (e.g. reconstructive surgeons, psycho-oncologists, GP) to know when they should attend. This is also the case for professionals accessing a virtual meeting from another hospital in order to discuss an isolated case.

(3) Establishing an alert system to notify the MDT if a given patient still needs essential test results before they can be discussed and to reschedule the case for the next MTM.

Recording MTM decisions and minutes – Instrument 7

Decision-making in MTMs produces information and medical summons for the patient. On the information side, most team decisions (which are generally set out or reflected in the treatment strategy and in other medical decisions) are recorded in the patient's EHR. That way, the information is accessible in the hospital context. However, these decisions are not normally recorded in a structured way but rather in the same free-text format used for other data, limiting their subsequent use as informative inputs. Interviewees considered that coding

or structuring this information should be a priority so that ICTs can help the team to understand in the long term how to make decisions and what impact these produce.

Another informative input derived from MTM are the *minutes* or the *report*, which synthesise the collective reasoning of the team and any potential divergences among its members. Residents, coordinators, and sometimes the doctors themselves are responsible for drawing up the document, and secretarial support is infrequent. The report is also mainly in a free-text format, which is seen as difficult to change considering that the decisions have to be qualified and discrepancies acknowledged. Usually a doctor validates the final report.

> *"From an IT perspective, structured reporting of decisions would be a big change. It's the clarity that changes, what you don't find on a free-text report."*

> *"In the minutes of the tumour board there should be a specific section in which professionals may state that they disagree with the decision taken."*

Management of patient appointments – Instrument 8

As a good practice, the boom in ICTs also affects the use of computers in the MTM, where the appointment summons generated throughout the discussion are automatically incorporated into the hospital agenda rather than being a pending action point for after the meeting. Many teams, however, do not perform this task in situ, increasing the team's subsequent workload. Having administrative support in the MTM helps, but generating patient summons is also facilitated by HIS that allow agile, real-time management.

> *"ICTs are mainly found before making decisions. Afterwards they don't help us: we don't have much time to arrange the citations, to follow and monitor patients, to look at the results and so on. This could make a difference in optimising the resources."*

C. Instruments for making decisions and evaluating quality of care

Clinical decision-support systems (CDDS) – Instrument 6

The presence of artificial intelligence (AI) in the sphere of MTMs, especially instruments like clinical decision-support systems (CDDS) that intend to aid clinical decision-making, provokes conflicting reactions. Professionals tend to be sceptical and have numerous misgivings about these instruments, but at the same time they are willing to experiment and discover their real potential. One example from the area of radiotherapy shows the capacity of data-driven machine learning to help physicians define the patient-specific dosimetric decision.[11] Another demonstrates how to overcome the barriers to translating pharmacogenomic testing into

clinical routine via CDDS.[12] There is even available evidence on the possibilities of using advanced CDDS to take full advantage of MTMs' potential.[13] One of the informants mentioned that he is applying two CDDS in his hospital (Gemelli University Hospital, Rome, Italy), namely, a supportive tool indicating patients' risk of local recurrence according to available data, and a process-mining software assessing to which extent physicians' choices comply with local guidelines. A repository for real-world data collection —including MDTs' decisions— has been implemented in the hospital HIS.

Nevertheless, many professionals are familiar with the 'failed' experience of the Watson programme in the Memorial Sloan-Kettering Cancer Center, which, in a nutshell, aspired to 'learn' the natural language of different types of medical reports (for lung cancer) in order to generate information.

> *"We all agree that AI may be a supportive tool but never replace the professional."*
>
> *"It can be dangerous at some point. It can save time, but this should not replace the MDT discussion about patient preferences, comorbidities, and medication."*
>
> *"Watson is not real AI. It relies on a big group of people putting data, it's deep learning. These are not neuronal networks, it's simply playing chess. You have all the moves and the computer can predict because it knows exactly all the possibilities. It's a bit tricky."*
>
> *"What the CDDS know depends on what you feed it, only. With real AI, you don't know the rules. Companies and start-ups are developing AI tools, but they're not validated or tested, really. The recommendations given by CDDS are absolutely artificial and mainly based on pre-existing scenarios."*

CDDS are instruments conceived to help professionals improve care by translating a great quantity of data into useful knowledge. Informants understand that CDDS need a large amount of clinical data to function well and propose treatment decisions. These systems are fed by pre-established clinical algorithms as well as real-world data on the team's decision activity. According to informants, CDSS pose three challenges:

- *Lack of trustworthiness*: CDDS are instruments that propose treatment strategies based on unknown criteria or criteria that may not have been clinically validated by a physician. They should have safeguards to ensure that decision-making is robust and reproducible. The risk of bias can lead to erroneous decisions, "*because where there seems to be causality, there is really only chance.*"

- *Continuous updates*: constant updates that take into account new scientific evidence are essential to avert their proposing of obsolete decisions.

- *Clinical complexity and patient preferences*: the chance of capturing all dimensions, including areas like oncogeriatrics, the psychosocial dimension, or patient preferences, is seen as difficult.

"These systems appear as a black box. You don't know what studies and data are in the algorithm. People are afraid because of that."

"There is a need for ensuring transparency regarding how the information is processed."

"Their database should be continuously updated if you want AI making decisions and trust it."

"AI may help but the model is not pressing a button and a decision is made."

"It is very difficult to replace the experience of expert professionals sitting at a table."

"It is not only about which chemotherapy; too much information is needed to design the best therapeutic strategy for the patient."

"*Interaction between drugs is one of the most evident challenges for a CDDS."*

"Once the rules are clear and the algorithm is validated … This can be a starting point."

The implementation of CDDS is still new, and it is discussed in terms of its future (rather than present) impact, and always with the premise that it will be no more than a supportive tool for professionals. One professional with experience using it in prostate cancer stated that while CDDS can help to make decisions about possible treatment strategies (namely, watchful waiting, surgery, or radiotherapy), their results or recommendations are rather simple and dichotomous. Another informant commented that *"frail old patients have much more toxicities concerning even treatments that are very well accepted in clinical trials, where they are clearly underrepresented."* For that reason, analysing medical charts as big data must allow the consideration of information that compensates or complements shortcomings of this kind.

In any case, today there is no shared vision about whether CDDS should be oriented toward 'simpler' or 'more complex' cases from the perspective of treatment planning, with complexity understood as instances where the non-oncological dimension is very relevant. Likewise, there is no common vision on whether a CDDS can include existing information on open clinical trials.

"It can give a recommendation, and you complete the picture with the rest of information."

"We can't say 'no' to the CDDS just to defend our jobs."

"Watson doesn't see the data from RCT and publications, so the main problem of tools such as Watson is that patients couldn't access some therapeutic options that can be an effective alternatives in some cases. These kind of 'last options' are not integrated in protocols, clinical practice guidelines, etc., and therefore they are not included in the software."

Provision of patients' genetic information – Instrument 7

Another area related to ICTs is in the area of genomics. Obviously, this report cannot go into the dimension of medical technologies, but some professionals signal that the emergence of so-called personalised medicine can ultimately have an impact on decision-making in MTMs. In fact, the idea of implementing molecular tumour boards has been raised due to the complexity of selecting patients and evaluating the different options according to the genetic information provided by next generation sequencing (NGS).[14] These tumour boards would be comprised of specialists in genetics, biology, medical oncology, and anatomical pathology.

> *"The MTM includes molecular information based on biomarkers like Ki67 or HER, but which originates in the immunohistochemistry and FISH, not in the NGS. We're still in the clinical era, but a transition has started."*

Regarding the need to improve the precision of clinical decisions, the informants generally pointed to the need for inclusion of patients in clinical trials with matched therapy. However, this consideration also has an impact on the care process as a whole because, among other things, MTMs must access the genetic information, and hospitals do not always have the appropriate technology. Such issues indicate the relevance of generating options on how to integrate this area into the operative processes of MTMs.

Evaluation of MDT process and clinical outcomes – Instrument 10

So far, ICTs have had a negligible impact on the evaluation of MDT activities and results. Discussions of this aspect often motivate allusions to the importance of the data manager, the figure who would help to understand and use such data. Without arguing this point, the data manager is mentioned due to the 'substitution effect' that they have in relation to hospital HIS, which again are not conceived as a tool for multidisciplinary work.

In the last several years, MDTs have become more consistent in terms of their organisation, working methods, and the definition of their role in clinical management. But the information systems have not kept up or adapted to specific changes at the multidisciplinary level (e.g. teamwork, nurse case managers). It is not unusual to see the generation of Excel or Access files recording MDT activities or results that are completely removed from the hospital HIS. These are mostly unsatisfactory experiences, as they depend solely on personal efforts (sometimes related to publications), and – informants insist – they undercut efficiency because there is no interface between these records and other operating systems. Furthermore, for the most part the records are generated retrospectively, with everything that implies in terms of added work and potential errors.

Some professionals do describe the implementation of evaluation systems in their hospitals that automate the measurement of toxicity, stages (I, II, II…), or other intermediate and outcome indicators. But these experiences are limited in number, as those functionalities are overwhelmingly related to the generation of structured data points; they cannot capture the context of free-text records in pdf form. Paradoxically, this situation predominates in

conventional patient care, while in clinical trials the activity registries are far more standardised and structured.

> *"Sometimes you only need something really important for clinical practice and you don't have it. There is also a lot of unnecessary data."*

D. Virtual multidisciplinary team meetings (MTMs)

Impact and use

Use of virtual MTMs is growing. Their implementation allows holding regular, multicentric meetings, so they are most often used at a regional level between tertiary and smaller centres. The experiences in European reference networks (ERNs) for rare diseases, or the rare tumour network in France, are good examples of the potential of virtual MTMs and their capacity to impact the wider healthcare system. This modality is used in different ways and responds to different, sometimes overlapping motivations. Primarily, virtual MTMs are used to:

- ✓ promote access to greater clinical expertise, which may come from other teams;
- ✓ obtain technical information due to gaps in access to technology, e.g. NGS data;
- ✓ improve clinical and care management in patients moving between centres;
- ✓ educate and train other teams in knowledge of the pathology.

Some professionals involved in virtual MTMs are wary of using them to justify the provision of treatments in centres that cannot guarantee adequate quality of care or patients' access to clinical trials. Thus, virtual MTMs should not aim to avoid referring patients to centres that can deliver higher quality care. However, they can serve to reach a consensus and coordinate provision of chemotherapy or patient follow-up by the local centre.

Likewise, asynchronous MTMs should not become the reference option, that is, a substitute for the synchronous model. Asynchronous MTMs discuss cases without involving the other institution where the patient is receiving care, even if that centre did prepare the information and test results on which the discussions and decisions are based. According to the informants consulted, these types of experiences indicate that asynchronous communication "*does not imply a real discussion*", and even though it saves time because there's no need to wait for a meeting, a better solution is to make synchronous MTMs more efficient.

Logistics and organisation

The celebration of virtual MTMs is steeped in complexities related to each hospital's ICTs and HIS. Overall, informants were positive about MTMs, including for cases in which one member of the MDT has to connect remotely. However, the following problems related to organisation and logistics were identified:

- *Incompatibility between HIS of different hospitals*, complicating access to information like the visualisation of images. This means that patients still have to carry around CD-ROMs or that professionals have to call other hospitals to obtain the original information, not just the summary.

- *Use of different clinical criteria for generating radiological images* (e.g. cutoffs) and differences in quality (e.g. resolution) that necessitate repeating tests, with the consequent delays and extra costs that this implies.

- *Privacy problems with the use of patient information* in other centres.

- *Difficulty managing time slots for discussion*. A hospital may want to discuss a case at a certain time, but one member of the MDT may be elsewhere and have to connect remotely, or the GP may want to join the virtual meeting.

"Videoconferencing with the GP is very satisfactory. But if we have the meeting before noon, then they can't participate because they have to see their patients. If the GP can access the discussion for 15 minutes from their smartphone, it makes it much easier."

"Patients sometimes do not allow the hospital to send their personal information to other hospitals."

"The organisation is not easy because you have to make an appointment from a distance to your MDTs and be able to know when to call in."

Spatial dimensions of virtual communication

Most virtual discussions take place between teams that see each other through a single screen and with a single microphone. On the screen, the videoconference alternates with radiological images, meaning that when these are presented, the teams cannot see each other, and if they do it is only in a minimised form on the side of the screen. This model of virtual communication works for some teams, while others lament the small size of the screen and the poor visualisation of other professionals – also sitting in a row, complaining that it hampers interaction and fluid discussion.

We did take note of one experience that found a solution to these limitations, in UZ Gent. This centre has an ICT room conceived to improve visual communication and participation between different professionals. It has eight screens throughout the room, along with four moveable cameras with different microphones. The cameras follow the person who is speaking in a semi-automatic way. With this change, professionals seated in a row do not have to work to make themselves seen and heard; rather, there is real multi-lateral and inclusive communication,

and all are equally present for those who are listening to them. Significantly, this MTM has one support professional.

> *"In 2006 we started teleconferencing in MDTs. And at the beginning there was one in the front discussing with the one on the screen. But if you want good discussion, and we looked at the literature, you cannot put people in rows after each other. Everyone should be in front of the camera and meet the station."*

Change management

The development of multidisciplinary cancer care involves sharing protocols, communicating and reaching a consensus on diagnostic and therapeutic visions, and identifying as a team with its own objectives. The use of ICTs is a relevant change in that the MTM can gain access to other specialists and teams with different objectives, resources, and levels of experience.

For that reason, and according to the informants consulted, change management is a relevant consideration because professionals' comfort with using ICTs is very low, and their reluctance can be evident. A typical case is the use of EHRs: there are professionals who believe in the utility of the instrument and fill in the data, and there are others who do not.

The learning process could be facilitated by training and dissemination activities. On the other hand, informants also mentioned the need to make investments in technology that are proportional to the needs of the team, acquiring good equipment, and to hire support staff to help during the transition period.

> *"A teaching course is needed during the adaptation period when ICT – such as digital programs – are implemented in healthcare centres."*

> *"It's a new way of working, and you need support from the secretary or someone running the MDT."*

> *"In the end, technology has to work. When you see the video but not the sound, for example, it's frustrating. Investment in good technology is very important."*

Privacy and confidentiality

Privacy and confidentiality are related to the legislation in each EU member state and their respective regions, but also to European legislation, namely the General Data Protection Regulation (GDPR).[15] Some informants said, for example, that *"physicians have to fill in a consent form in order to communicate and exchange patient information between centres"*, while for others this is not the case. A few pointed out that a shared HIS among several hospitals prevents this from being an obstacle. The experience of some centres, which send a link to patients' EHRs when they are referred, is also a relevant example of how to address this issue. The links to the EHRs are configured to expire within two hours, avoiding privacy and confidentiality problems related to accessing clinical data in patients receiving treatment in other hospitals. In other cases, these virtual access points do not expire, but the information contained therein is limited.

In any case, the reality is that the regionalisation of services, due to centralisation policies or networks that share care processes among different hospitals, has highlighted the importance of such concerns. In this context, legislation can be an added obstacle to contact between centres, on top of the problems derived from lack of standardised operation systems.

"Within the networks the rules are quite clear; outside, not that much."

Conclusions

1. The impact of ICTs and hospital HIS signal a second transition in the development process of MDTs. ICTs are directly transforming the informational and decision-making processes (e.g. through virtual MTMs), but they are also indirectly driving the incorporation of other functions (e.g. use of PROMs, access to molecular information) which also leads to changes in these processes. Digital and dynamic interaction of teams within their working the ecosystem (the hospital and beyond) will continue to gradually transform the MDT model away from discussions and decision-making from within an isolated room. Opening MTMs to professionals and teams in other institutions through virtual MTMs, and to patients through registries that influence these processes in real time, entails profound changes in clinical decision-making, as does the uptake – so far limited – of operating systems that facilitate these processes.

2. Although good practices exist for achieving what could be considered an integrated information environment, in general the information contained in hospital HIS is not organised along care processes; instead it is based on reports and clinical services. The combination of 'passive' HIS – conceived to hold information, not to work with it – and the massive generation of unstructured data in the form of free-text pdf files, is the clearest expression of the gap between MDTs' information needs and the adequacy of current information systems. On top of these challenges, there are problems related to interoperability between HIS, both between and within hospitals.

3. There is little concordance between the level of technological development and the level of MDT organisation, the latter of which is clearly more advanced. In the process of preparing and organising MTMs, there are important differences between teams, for example, with regard to the use of an electronic multidisciplinary agenda, the possibility of directly transferring images from the PACS station to the MTM or of easily accessing the patient's EHR during the MTM. The internal efficiency and synchronisation that these teams gain by using such instruments is evident, but only up to the celebration of the MTM. Following the meetings, there are no major differences between teams. A typical example is the use of data for evaluating MDT activities; this is usually non-existent because it depends on the structuring of data, which rarely occurs.

4. The information management context is important and directly affects the ability of the team to generate data or assess its own performance. The adoption of ICTs does not preclude professionals' and MDTs' need for support. The existence of a data manager or administrative or IT support should accompany the implementation and use of ICTs. These technologies may increase the efficiency and improve the functioning of the MTM, but they do not eliminate all the associated workload. On the

contrary, ICTs may generate additional tasks for professionals, especially during the implementation period when the new tools are being introduced.

5. ICTs are the lever that could allow the regular consideration of PROMs as inputs into informational and decision-making processes. Incorporating real-time PROM data generated by patients into MTMs could improve the appropriateness of the decisions made and the need to re-discuss cases. ICTs can permit patient-level information to be included in a direct and structured way within the care process, contributing to keeping patients engaged throughout their cancer care journey.

6. There has been limited implementation of clinical decision-support systems (CDDS) as artificial intelligence systems intended to facilitate decisions between different treatment strategies. In fact, the relevance of their role in decision-making processes is still perceived as distant. However, the reality of these systems poses ethical dilemmas and provokes misgivings related to clinical complexity and patient preferences, which these systems cannot yet capture. Other considerations include the need for constant updates and the lack of trust in the criteria used to establish the treatment strategy. At the same time, a number of professionals are also experimenting with the systems.

7. The lack of standardisation in interhospital relations in terms of IT is very detrimental for coordinating work between teams and professionals from different institutions. Interhospital patient flows (or patient information flows) for referrals or discussions are increasing, buoyed by the successful European experiences in creating networks and partnerships between hospitals. However, professionals must often spend considerable time in collecting all kinds of information (e.g. radiological data) from another hospital, generating delays and – worse – leading professionals to make decisions without having the original information. In contrast, in regional healthcare systems that use a unified HIS (and thus a single patient EHR), care processes are managed more agilely and efficiently.

8. Holding virtual MTMs requires clinical and care criteria (that is, not technological criteria) that have been agreed on by all participating professionals. It is true that the organisation of virtual care processes is conditioned by factors at the health system level, such as the legal framework on privacy and confidentiality for exchanging patient data, or the interoperability between hospital information systems. However, there are other meso-level issues that need to be actively managed. These include the criteria for case complexity that trigger a patient referral (rather than just their virtual discussion), or which instead prevent transfers because high quality care can be guaranteed in the local centre. The team must also agree on criteria for generating radiological images to avoid problems in access, delays, and repeated tests.

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Annex 1. Sample of expert professionals consulted

Lissandra Dal Lago, International Society of Geriatric Oncology (SIOG)

Johan de Munter, *European Oncology Nursing Society (EONS)*

Karolien Goffin, *European Association of Nuclear Medicine (EANM)*

Eugen Javor, *European Society of Oncology Pharmacy (ESOP)*

Claudio Lombardo, *Organisation of European Cancer Institutes (OECI)*

Jordi Ponce, *European Society of Gynaecological Oncology (ESGO)*

Daniele Regge, *European Society of Radiology (ESR)*

Ramón Salazar, *European Society of Medical Oncology (ESMO)*

Vincenzo Valentini, *European SocieTy for Radiotherapy & Oncology (ESTRO)*

Annex 2. Interview and focus group questions

1. Multidisciplinary team meetings

1.1 Data collection and accessibility

How the agenda of patient is fulfilled
How the collection of patient information takes place (sources; use of EHR)
Capture if non-cancer related data, if existing
Is the case presentation structured? And electronically linked?

1.2 Case Presentation

Pre-treatment digitised images required (e.g., uality criteria and problems of is displaying;
Interoperability with other institutions and IT systems integration (e.g., degree of standardisation)
Technological conditions (e.g., high-definition projector to display images; double-screen; PCs in the room to organise appointments or to consult EHR/hospital intranet)
Clinical decision-support systems (i.e., layers of information like protocols; technology at the frontline)
Use of PROMs

1.3 Results and practical implications of tumour board discussions

Minutes of the TB: availability and accessibility
Registration of decisions (EHR)
Organisation of medical appointments
Evaluation of team results facilitated by HIS (e.g., activity and results such as toxicity, QoL issues, survivorship, etc.; MTMs information as output)
Evaluation/data generation in terms of big data/RWD

2. Virtual MDTs

2.1 Experience and types

HVH and HVH/HVH and LVH; dispersed members; contact to other specialists or primary care physicians

2.2 Organisation and implementation

Checklist-preparation; advantages and problems of virtual MDTs; interoperability; privacy and confidentiality of patient data

2.3 Critical elements

Reliability of technology; difficulty in using technology outside a single organisation virtual consultation of tests additional preparation of the meeting

2.4 The way forward: future goals