Critical Reviews in Oncology / Hematology 204 (2024) 104531

Contents lists available at ScienceDirect

Critical Reviews in Oncology / Hematology

journal homepage: www.elsevier.com/locate/critrevonc

Scientific Communication and oncology – "The bridge between knowledge and patients"

Antonio Galvano [a,1], Andrea Gottardo [a,1], Valerio Gristina [a], Daniele Fanale [a], Lidia Rita Corsini [a], Carlo Pavone [a], Tancredi Didier Bazan Russo [a], Emilia Di Giovanni [a], Giuliana Iannì [a], Ugo Randazzo [a], Federica Iacono [b], Alessandro Perez [a], Chiara Brando [a], Marco Bono [a], Viviana Bazan [c], Lorena Incorvaia [a], Giuseppe Badalamenti [a], Saverio Cinieri [d], Mauro Boldrini [e,2], Rossana Berardi [f,2], Antonio Russo [a,*]

[a] Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo, Palermo, Italy
[b] Oncology Unit, ARNAS Civico, Palermo, Italy
[c] Department of Biomedicine, Neuroscience and Advanced Diagnostic (Bi.N.D.), University of Palermo, Palermo, Italy
[d] Medical Oncology Unit, Antonio Perrino Hospital, Brindisi, Italy
[e] Intermedia s.r.l. per la comunicazione integrata, Via Lunga 16/a, Brescia, Italy
[f] Department of Medical Oncology, Marche Polytechnic University, Ancona, Italy

ARTICLE INFO

Keywords:
Scientific Communication
Scientific method
Medical communication
Oncological communication
Psycho-oncology
Guidelines

ABSTRACT

The communication of scientific knowledge to patients and society as a whole has never been more central than in modern times. Thanks to the recent pandemic, it has become evident how Scientific Communication (SC) has evolved over time, increasingly diverging from common language. However, it is also clear that it must be properly used by healthcare professionals to avoid comprehension issues that could be severe for the audience. Presently, science and technology are at the heart of progress and innovation; therefore, the proper dissemination of accurate yet accessible information to the population is vital to ensure that no one is left behind and to promote cohesive social advancement. This review aims to analyze the notions of SC and Scientific Method (SM), examining the relationships between them and providing suggestions on how to integrate them properly in both a broader context and the specific field of communication with oncology patients.

Abbreviations: AIOM, Italian Medical Oncology Association.; ASCO, American Society of Clinical Oncology.; BNI, Brief Negotiated Interview.; CDSS, Clinical Decision Support System; COMU, Board of University Medical Oncologists.; DIY, Do-It-Yourself.; DNR, Do-Not-Resuscitate.; ED, Emergency Department.; EHealth, electronic Health.; EHR, Electronic Health Records.; EoL, End-Of-Life.; ICT, Information and Communication Technology.; IPBR, immediate Postmastectomy Breast Reconstruction.; NCCN, National Comprehensive Cancer Network.; NURSE, Name, Understand, Respect, Support, and Explore.; NIH, National Institute of Health.; PC, Palliative Care.; PDA, Patients' Decision Aids.; PN, Patient Navigation.; PPC, Patient-Physician Communication.; SC, Scientific Communication.; SDM, Shared Decision Making.; SM, Scientific Method.; SPIKES, Setting, Perception, Invitation, Knowledge, Empathy, and Summary.; UI, User Interface.

* Correspondence to: Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), "P. Giaccone" University Hospital (A.O.U.P.) of Palermo, Via del Vespro 129, Palermo 90127, Italy.

E-mail addresses: antonio.galvano@unipa.it (A. Galvano), andrea.gottardo@unipa.it (A. Gottardo), valerio.gristina@unipa.it (V. Gristina), daniele.fanale@gmail.com (D. Fanale), lidia.corsini@gmail.com (L.R. Corsini), carlo.pavone@unipa.it (C. Pavone), tancredididier.bazanrusso@you.unipa.it (T.D. Bazan Russo), emilia.digiovanni@community.unipa.it (E. Di Giovanni), giulianagiuseppina.ianni@you.unipa.it (G. Iannì), ugo.randazzo@you.unipa.it (U. Randazzo), fed.iacono@gmail.com (F. Iacono), ale-like@libero.it (A. Perez), chiabra92@libero.it (C. Brando), marcobono29@gmail.com (M. Bono), viviana.bazan@unipa.it (V. Bazan), lorena.incorvaia@unipa.it (L. Incorvaia), giuseppe.badalamenti@unipa.it (G. Badalamenti), saverio.cinieri@me.com (S. Cinieri), mauro@intermedianews.it (M. Boldrini), r.berardi@staff.univpm.it (R. Berardi), antonio.russo@usa.net (A. Russo).

[1] These Authors have contributed equally to this work.
[2] Co-last Authors

https://doi.org/10.1016/j.critrevonc.2024.104531
Received 19 April 2024; Received in revised form 2 August 2024; Accepted 7 October 2024
Available online 18 October 2024

1. Introduction

The definition of some indications to Italian oncologists towards communication with their patients was a matter of discussion for the *Italian Medical Oncology Association* (*AIOM*) and *AIOM Foundation* during the *Board of University Medical Oncologists* (*COMU*) *Course*, in Palermo in November 2022. On this occasion, highly topical issues were discussed, concerning, e.g., *Scientific Communication* (*SC*) in the digital age, the differences between dissemination by newspapers, radio, and television, information through the web, and communication between oncologist and patient.

Hence, the mission of this review is to gather all that has been said in one place, arguing and corroborating it through an in-depth study of the different topics covered and the different aspects of SC, both generic and in the specific field of oncology. By doing so, it is hoped to achieve the vision that guided us, AIOM oncologists, during the COMU course, which is to raise awareness among clinicians and disseminators toward the proper use of *Information and Communication Technology* (*ICT*)-mediated communication and to prepare oncologists to approach the relationship with their patients in a way that not only improves their health indicators and treatment outcomes, but also their quality of life and psychophysical health.

2. Methods

Having noted the main topics covered during the course, the data acquisition phase involved research and in-depth study of all topics covered therein; the sources used were both academic (i.e., MEDLINE via *PubMed* & SCOPUS via *ScienceDirect*) and gray literature (i.e., Google Web). Precisely, we assessed the former multiple times, to evaluate if there are quantitative studies regarding the arguments treated herein; the strings and the filters used are in [*Supplementary File 1*]. After assessing the high heterogeneity of the selected papers by the former sources, we collected the most relevant studies, and we integrated them with the results found within the latter source. Next, the data analysis & interpretation stages involved the screening, selection and digital summary of the collected information and articles, ensuring the accuracy of the information reported in the review by manual double-check of every report obtained. Then, the draft writing phase brought together all the information gathered during the COMU course and the subsequent research reports, as foreseen by the mission that guided the authors of this manuscript. Finally, it was the task of a select group of authors to carry out the draft review, who through their valuable input were able to make the knowledge produced in the previous stages cohesive and reliable, making skillful changes where deemed necessary.

3. Modern problems require modern (communicative) solutions

The concept of SC and its relevance in society are of utmost importance (https://cordis, 2023). Science is the driving force of human progress, bringing innovations that change people's daily lives. However, scientific discoveries are often complex for the general public, being rich in technicalities and therefore fully understandable only by specialists. It is in this context that effective SC can make a difference, translating these complexities into a format understandable to the majority. Its primary mission is to ensure that information is not only accurate and reliable but also accessible to everyone, including those who are unfamiliar with the topic. Moreover, an informed society is more likely to support scientific research and innovation. Thus, even in non-clinical contexts, SC plays a fundamental role (https://magazine, 2023). For example, during epidemics or environmental crises, communication based on scientific data is essential for making informed decisions and taking necessary precautions. Accurate and timely information can, therefore, make the difference between an effective response and an escalation of critical situations. This occurs because many of the most pressing issues faced by society, such as climate change, food security, and public health, require an in-depth understanding of their scientific foundations, i.e., a minimum level of scientific literacy (Laugksch, 2000) among the population, to be effectively addressed.

Therefore, SC can educate the public on such issues, promoting collective action within the principles of a democratic society where the population is called upon to make informed decisions. In this sense, SC provides a solid foundation for understanding even the most pressing and complex sociopolitical issues, by assisting in making decisions, including political and legislative ones. Without a deep understanding of scientific matters, decisions might otherwise not be data-driven or could be influenced by the ever-growing misinformation, as already seen in cases like climate change or vaccines. Conversely, effective SC can inspire young individuals to adopt responsible behaviors and pursue scientific careers (https://www.quotidianosanita, 2023; https://www.epicentro, 2023): indeed, when young people are effectively exposed to science, they are more likely to develop an interest in it and adjust their behaviors to align with new evidence. This contributes to maintaining a solid and innovative scientific knowledge base for the future, ensuring that research and innovation will continue to thrive.

4. Scientific Method

Now that the importance of SC for society has been depicted, it is time to examine why the *Scientific Method* (*SM*) is fundamental in approaching communication with the public (https://www.metodologiedidattiche, 2023). SM is a rigorous process based on the collection of empirical data, observation, analysis, and verification, ensuring the reliability and credibility of the so-gathered information. Indeed, one of the main reasons why SM is crucial in SC is its ability to confer reliability and credibility to information. When data and evidence take center stage, communication becomes more credible, and the public is more likely to accept it as truth. However, this data and evidence need to be presented in clear and simple language to help the non-scientific audience understand its meaning and implications. SM promotes critical thinking and objective evaluation of evidence. Such ability is essential for the public as it teaches them to ask questions, assess sources, and be critical of claims unsupported by solid evidence, enabling individuals to discern between credible scientific information and pseudoscience or misinformation (Polizzi, 2006).

Another fundamental aspect of SM is transparency in data collection and analysis: the results of scientific research are open to inspection by other experts, further enhancing their credibility. The ability to verify and repeat experiments and analyses helps eliminate doubts about the credibility of proper scientific claims. Realistic communication about the limits of scientific knowledge assists the public in developing accurate expectations and avoiding illusions or misunderstandings about science itself (Tremolada, 2022; https://www, 2023). The application of SM in communication through SC by both the speaker (who created the speech based on the SM) and the audience (who actively listen, with a critical ear, to what is reported) can, therefore, generate interest in science and research, leading to all the aforementioned benefits, foremost the prevention of misinformation, another crucial aspect of SC. In the era of digital information, the rapid dissemination of misinformation poses significant risks (Roberto, 2022). For instance, a study (Johnson et al., 2022) analyzing 200 highly circulated social media articles on the four most prevalent cancers (breast, colorectal, prostate, lung), discovered that nearly one-third (30.5 %) conveyed hazardous information. Such misinformation could potentially lead individuals to delay or forego life-saving treatments, resort to unsafe DIY methods using toxic substances, or choose scientifically invalid alternative therapies. Alarmingly, these articles gained substantial attention, averaging 2300 shares, surpassing certified news articles averaging 1500 shares. Using SC rooted in SM stands as a pivotal approach to combat this dissemination, offering a credible, evidence-based alternative.

5. Strategies for accurate information

Before discussing effective communication strategies with both the general public and oncology patients, it might be useful to establish a framework for those encountering unfamiliar concepts. This applies whether one is a healthcare professional seeking updates in related yet non-direct fields or an ordinary citizen encountering scientific articles online; moreover, regardless of occupation, this may be more relevant in general for adults than for young people, as the former have significantly more difficulty in performing accurate computer searches than the latter (Chevalier et al., 2015).

When evaluating the credibility of health-related information, several factors warrant consideration (https://www.corriere, 2023). Firstly, scrutinizing the credentials of the individual presenting the information is crucial. Their expertise should align with the topic at hand, providing assurance of accurate and reliable insights. Furthermore, the timeframe of the information must be assessed. In the rapidly evolving landscape of healthcare, even a slight time lapse can result in significant advancements. It's imperative to ensure that the information remains current and reflective of the latest developments in the field. Maintaining a balanced perspective is essential. Information should be devoid of sensationalism, with an emphasis on the need for personalized guidance from a healthcare professional. This underscores the importance of consulting with a specialist to ascertain the relevance of the information to one's specific circumstances. Additionally, references to reputable institutional entities serve as markers of credibility. These affiliations validate the reliability of the information presented, instilling confidence in its accuracy.

It's also prudent to exercise caution when encountering certain types of information. This includes content promoting "one-size-fits-all" solutions or attempting to sell products. Similarly, information solely sponsored by private companies may carry biases that compromise its objectivity. Moreover, vigilance is required regarding references to "alternative" figures or unsubstantiated claims that undermine conventional medicine. Such assertions can perpetuate unfounded conspiracy theories and erode trust in evidence-based practices.

Ultimately, approaching information with a critical eye is paramount. Avoiding confirmation bias and refraining from self-diagnosis and treatment attempts are essential practices. These endeavors pose challenges even for medical professionals, underscoring the importance of seeking guidance from qualified experts.

6. Approaches for an effective SC

Taking into account what has already been observed, let's now assess the most effective strategies for successful SC (summed up in [Fig. 1]):

- **Simplifying without distorting**: Effective SC requires targeted approaches that convey complex scientific information in a clear, accessible, and engaging way. Simplifying complex scientific concepts is essential, but it is imperative to do so without distorting scientific truth, using appropriate analogies and metaphors to explain concepts understandably. Indeed, presenting information in a narrative context makes it more personal, meaningful, and, consequently, easier for the audience to memorize and understand. Additionally, employing graphs, images, and visualizations to represent scientific data and concepts proves beneficial; visual communication often excels in conveying complex information (Perra and Brinkman, 2021). Tailoring communication to the needs and interests of the audience remains pivotal (Hutchins, 2020). Scientific evidence suggests that scientists must skillfully manage different types of audiences through various forms of communication (i.e., oral or written). Considering the audience's concerns and experiences makes information more relevant to them, but a personalized approach that accommodates different perspectives and knowledge levels is mandatory.
- **Order matters**: It is essential to identify the key message, the basic concept to underline, and address it immediately. In fact, time is often very limited during intervention in radio or TV; therefore, it is necessary to be brief and get straight to the point (https://www.frameworksinstitute, 2023). Moreover, as opposed to what is usually seen in scientific articles, it is recommended to first provide essential information; this may be difficult to apply for the specialist, which is used to write using the classical order in which premises, methodology, intermediate experiments etc. precede the results achieved and the conclusions. Nonetheless, when addressing lay media, it is essential to proceed exactly in the opposite way (Hutchins, 2020): first, identify the key news (the conclusions), then, if there is space and time, provide the information necessary to contextualize the news or the data. Finally, on this behalf, it is always advisable to cite data (numbers, percentages, comparative data, etc.) and sources: this is an expression of seriousness and expertise, which increases reliability and authority. It is also important to contextualize these elements.

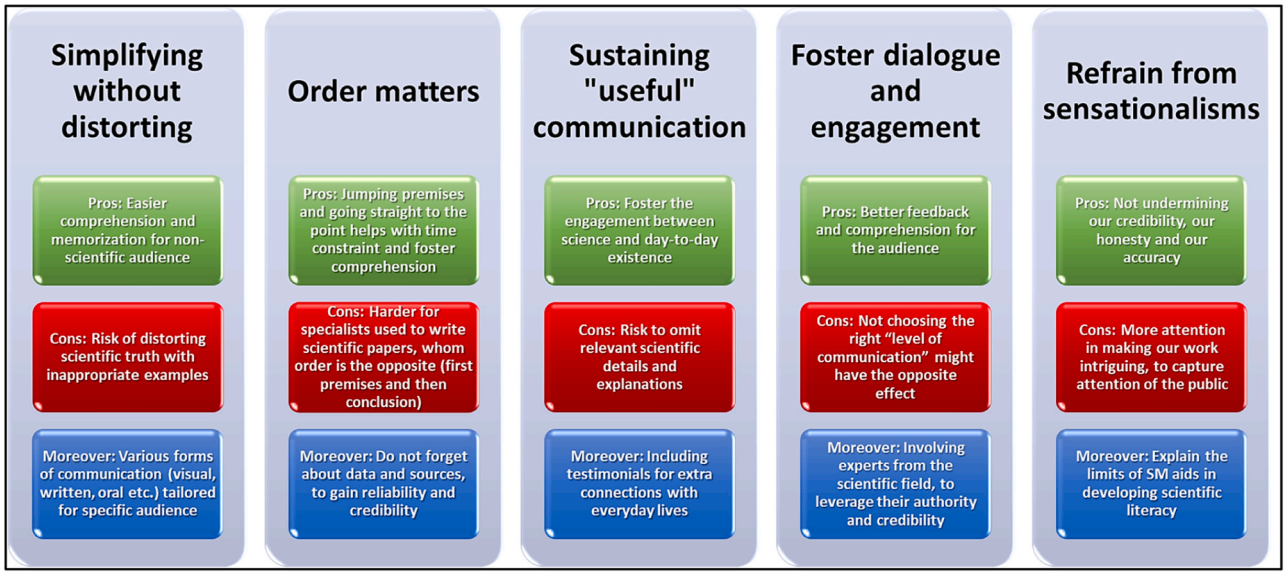

Fig. 1. Approaches for an effective SC.

- **Sustaining "useful" communication**: Demonstrating the relevance of science to the daily concerns of the public is of utmost importance (https://www.uab, 2023). Individuals are more likely to pay attention and be engaged when they perceive a connection between science and their everyday lives. For instance, establishing links between scientific research and personal health or environmental issues can underscore the significance of science in day-to-day existence. When suitable, including testimonials and personal experiences can establish an emotional connection with the audience, as personal narratives tend to make information more relatable and significant. However, it is crucial to strike a balance by supplementing these stories with robust scientific data to prevent any potential bias.
- **Foster dialogue and engagement**: It is crucial to respond to queries, welcome comments, and promote feedback, as this fosters a sense of participation and involvement among the audience (Tran, 2008; Dahm et al., 2019). Involving experts from the scientific field in conveying information is a significant practice; their authority and credibility can enhance the public's confidence in the information presented. However, experts must communicate understandably and engagingly, avoiding the excessive use of technical terms. Identifying the most suitable communication channels for the target audience is equally vital; such channels may encompass social media, websites, accessible articles, public lectures, television programs, podcasts, and various other media outlets (Rovelli, 2023). Additionally, considering the scientist's comfort level with each form is beneficial, as each has its strengths and weaknesses. For instance, a live talk allows interaction with the audience, potentially enhancing engagement, but it requires effective oratory skills, which may not always be fully developed by researchers. Conversely, a pre-recorded video may lack direct interaction with the audience but could aid the researcher in conveying their work's results more fluently.
- **Refrain from sensationalisms**: SC demands honesty and accuracy. While sensationalist headlines may gain attention, they can also distort scientific reality and undermine communication credibility (https://www.corriere, 2023; Hurst, 2016). Providing explanations on how to critically assess sources and grasp the fundamentals of SM is imperative. This aids the public in developing scientific literacy skills, enabling individuals to critically evaluate scientific information and discern between reliable and unreliable sources.

7. Communicating within oncology departments

What has been discussed so far may pertain to oncology only in a broad sense, as a topic to be addressed in a classroom, seminar, or journal. However, it is not sufficient to understand how a healthcare professional should communicate with their oncology patients. Nowadays, the theme of communication in oncology is becoming increasingly prominent, with numerous articles and even specific guidelines, such as those from ASCO (Gilligan et al., 2017) and NIH – the latter, in particular, has a dedicated guide for patients and their families (https://www.cancer, 2023a) and one for clinicians (https://www.cancer, 2023b). This is because a cancer diagnosis will significantly impact the life of the patient and their entire family (Li et al., 2020). Effectively communicating in such an emotionally stressful context becomes a challenging task for the clinician, especially in busy departments that limit available time and further stress the professional (Gilligan et al., 2017). Moreover, the uncertainty of prognoses for some oncological conditions complicates matters even more, as stated by LeBlanc *et al* (LeBlanc et al., 2019).: on one hand, the doctor might tend to provide a more optimistic prognosis to the patient, perhaps already optimistic in itself or to avoid overly demoralizing the patient and their family; however, this would not provide accurate information to the patients. On the other hand, the doctor might present an overly negative point of view of the situation, which could be resolved by new drugs recently introduced into the market (as seen in the example of new immunotherapies).

Nevertheless, more recent studies mentioned in LeBlanc's article (LeBlanc et al., 2019) fortunately rule out this type of practice in clinical routine, also because it has been found that *«prognostic disclosure to an advanced cancer patient is not associated with sadness, anxiety, or poor patient-clinician relationship ratings. Similarly, prognostic information disclosure is not associated with increased parental anxiety, depression, or diminished hope; rather, disclosure increases hope. Efforts are needed to improve clinicians' understanding of these issues, and communication skills training interventions can further support hope, oncologist trust, and peace of mind»*.

Therefore, it is understood that effective patient-physician communication (PPC) is fundamental to the patient's ability to make decisions about the course of action. Moreover, it is scientifically proven that this helps develop hope, trust, satisfaction, and serenity in oncology patients (Sisk et al., 2018). These factors even have a clinical effect in certain situations, such as strict adherence to therapeutic guidelines when patients are correctly informed about their situation and fully satisfied with their relationship with their doctor (https://www.cancer, 2023b).

On this regard, as said in the *Method* paragraph, we tried to assess quantitatively if and how much the effective PPC might exert some clinical effect. Unfortunately, the available literature was too heterogeneous to make any structured, aggregated analysis. Therefore, we only show in the following [Table 1] the most relevant articles found by our research that included a quantitative analysis of the outcome of the planned intervention regarding communication strategies.

So, considering what yet said and the above result, what are the factors to consider when approaching communication with oncology patients? Several studies assert that there is both a demographic and cultural component in the type of communication required by patients. Factors such as age, gender, nationality, and education can significantly influence the type of communication required by patients, ranging from the mere provision of clinical information to a dialogue primarily focused on how to emotionally handle their situation (Chaturvedi et al., 2014). Additionally, various psychological factors, including denial, depression, and hope, can influence patients' understanding (LeBlanc et al., 2019), which is not constant but varies throughout the entire treatment period. Therefore, the type of communication must vary during oncology patient care (Li et al., 2020): in the early stages of diagnosis, patients need to hear the "bad news" from healthcare professionals and receive emotional support to face the subsequent steps. Before starting treatment, patients need to communicate with a professional who helps them choose the right therapy. At the end of treatment and during the recovery phase, oncology patients need more emotional support from healthcare professionals. In the advanced stage of the disease, patients need more reassurance from healthcare professionals, who must balance authenticity with hope. Finally, cultural factors and the patient's family context can determine the success of communication with healthcare personnel (Sisk et al., 2018): an undue reluctance toward strangers, patriarchal and/or strongly authoritarian societies, religious beliefs, and language barriers are all factors to be strongly considered during any medical consultation, as they can significantly influence the patient's perception of the situation and the choices they will make for their therapeutic journey.

According to ASCO's guidelines (Gilligan et al., 2017), oncologists can enhance communication with their patients through specific practices (https://ascopost, 2023):

- Initiate conversations by asking patients about their understanding of their disease and collaboratively set an agenda to address the issues most important to patients, family members, and the clinician.
- Engage in behaviors fostering trust, confidence, and collaboration by reviewing the patient's medical chart in advance, being friendly yet professional, making eye contact, practicing reflective listening, understanding how cancer has changed the patient's life, inquiring about coping mechanisms, and being honest, genuine, and respectful.

Table 1
Results of research involving quantitative data.

[Cit.]	First Author (Year)	What they made	What they obtained
(Bouleuc et al., 2021)	Bouleuc C. (2021)	Question Prompt List (QPL) to promote discussion during outpatient palliative care (PC) consultations.	Increased nr. of questions (about PC and End-of-Life (EoL)) and patient satisfaction (with his physician); no changes in psychological parameters; reduction in avoidance coping responses.
(Chawla and Arora, 2013)	Chawla N. (2013)	Evaluations about cancer patients' decision-making preferences the effect of these preferences on health outcomes.	61 % preferred SDM, 16.1 % preferred their control, 22.1 % preferred physician control; different responses correlate with behavioral and phycological differences; no changes in clinical outcome.
(Cheng et al., 2019)	Cheng Y.-H. (2019)	Investigation about the effect of training in a SHARE communication course by emergency physicians on patient notification and signing of do-not-resuscitate (DNR) orders for critical patients in the emergency department (ED).	78.3 % of families signed a DNR when physicians had SHARE communication training, compared to 39.1 % without training ($p = 0.017$). Key factors included a quiet environment, understanding patient wishes, and expressing concern.
(Chiang et al., 2015)	Chiang T.-Y. (2015)	Evaluation about factors correlated to refusal of treatment in cancer patients.	1.69 % = rate of refused treatment. High-risk factors for refusal included concerns about adverse effects, poor performance, changes in medical condition, timing and methods of case manager contact, and frequent contact by case managers (≥10 times).
(Currier et al., 2022)	Currier J. (2022)	Communication strategies to increase lung cancer screening in a rural community hospital	4.8-fold rise in first year and 54 % increase in second year. Adherence rates was 51 % in first year and 59.6 % in second year. Overall cancer detection was 2.11 %, with 66.6 % of detected cancers being stage I or II.
(Leiter et al., 2018)	Leiter R.E. (2018)	Brief negotiated interview (BNI) in ED to empower older adults with life-limiting illness to formulate and communicate medical care goals to their clinicians.	The majority (75.6 %) of recordings met the prespecified threshold for high intervention fidelity; no associations between clinician type or background with intervention fidelity recorded.
(Mahmoudi et al., 2017)	Mahmoudi E. (2017)	Association analysis with mandatory PPC and reduced racial/ethnic disparities in immediate Postmastectomy Breast Reconstruction (IPBR).	No overall change in IPBR rate or disparity between whites and African Americans (1 % reduction). Disparities reduced by 9 % between Hispanic and white patients and by 13 % between other minorities and white patients.
(Spiers et al., 2018)	Spiers S. (2018)	Comparison of the reasons for attritions in the first and second wave of a clinical trial (and to racial/ethnic differences) by prostate cancer patients.	Several demographic parameters found predictors of overall attrition, and differences were found between first and second waves.
(van der Velden et al., 2024)	van der Velden N.C.A. (2024)	Assessment of effect of different prognostic communication strategies on prognostic perceptions, treatment decision-making and EoL anticipation in simulated cancer patients.	Prognostic disclosure made individuals more likely to perceive dying within a year, feel better informed, and favor chemotherapy compared to non-disclosure or unpredictability. Numerical estimates enhanced understanding and decision-making more than word-based estimates. No significant effects on EoL anticipation or individual characteristics were observed.
(Wang et al., 2021)	Wang T.-J. (2021)	Evaluating the efficacy of an e-book decision aid and guidance of a decision coach in patients with elevated serum prostate-specific antigen. The intervention group received the decision support intervention and the control group received health education.	Intervention group showed higher knowledge scores at baseline. Post-intervention, significant improvements in knowledge (+11.75 %), decision self-efficacy (+76.45 %), and reduced decisional conflict (−23.53 %) were observed. No significant change in willingness for prostate biopsy was noted.
(Yeoh et al., 2018)	Yeoh Z.-Y. (2018)	Assessment of one-year efficacy of patient navigation (PN) in a Malaysian state-run hospital, regard the impact on diagnostic and treatment timeliness for breast cancer patients.	PN improved timely mammography (96.4 % vs. 74.4 %), biopsy (92.5 % vs. 76.1 %), and communication (80.0 % vs. 58.5 %). It also reduced treatment defaults (4.4 % vs. 11.5 %). Among navigated patients, emotional and language barriers were linked to late-stage presentation. The main reason reported for delay, default, or refusal of treatment was the preference for alternative therapy.

- Provide diagnostic and prognostic information tailored to patients' needs, ensuring their understanding of prognosis and treatment options. Clarify treatment goals, such as cure vs. prolongation of survival vs. quality of life, aligning with patients' values and priorities. Address concerns about the cost of care, offering direct solutions or referring patients to financial counselors or social workers.
- Initiate conversations about EoL preferences early in the incurable illness, revisiting the conversation when there are significant changes in the patient's condition or disease course.
- Present all treatment options, including clinical trials or PC alone if appropriate. For patients with incurable cancers, discuss the option of starting PC simultaneously with active cancer therapy.

Additionally, ASCO's guidelines recommend providing communication skills training for oncologists at every practice level. The training should emphasize skills practice and experiential learning using role-play scenarios facilitated by trained instructors and direct observation of patient encounters. Structured feedback in skills-practice exercises is recommended to help clinicians identify effective behaviors and areas for improvement.

Finally, the eHealth sector is also working to overcome these communication barriers between patients and clinicians (https://www.cancer, 2023b): an example may be the so-called Patients' Decision Aids (PDAs) (Olling et al., 2019), a specialized sub-class of Clinical Decision Support Systems (CDSS) which is integrated with Electronic Health Records (EHR) and the latest international guidelines. During medical visits, PDAs help patients understand their health condition and make informed decisions about their clinical journey, aligning with the principles of Shared Decision-Making (SDM). However, their true effectiveness is still under evaluation, especially due to a lack of standardization of such software or such intervention (Yen et al., 2021).

8. Oncological communication decalogue

Focusing upon the most used guidelines (Gilligan et al., 2017; https://www.cancer, 2023a, 2023b), ten short questions and answers were proposed, in order to promote meaningful communication. The following [Table 2] will report them hereafter.

9. Conclusion

SC stands as a pivotal element in the advancement and innovation of contemporary society. Scientific information comprehensible and accessible to the public is paramount for fostering a knowledge-driven society and tackling the global challenges that lie ahead. It plays a crucial role in ensuring the reliability and credibility of scientific information disseminated to the public. By implementing targeted strategies, it is possible to significantly enhance SC, fostering improved comprehension and engagement of the public in scientific endeavors. Furthermore, effective SC becomes a vital variable in oncological treatments, as patient-clinician compliance is central to addressing such devastating illnesses. Indeed, scientific community should strengthen the effort to quantitatively evaluate the impact of communication strategies in terms of clinical outcomes, e.g. evaluating changes in rate of refused treatment through varying type of SC. By doing so, more accurate analyses could be made, allowing for a better understanding of what kind of treatment (not only medical, but also personal and human) is needed as the boundary conditions of the patient under examination change. Therefore, seems reasonable affirming that, even through the application of apposite guidelines in a specific context, such as the oncological one, effective SC serves as a bridge to link scientific and medical knowledge to society, forging a world where science can flourish and benefit everyone, whether healthy or not.

Critical View

To the best of our knowledge, our article is the only one that link both scientific dissemination and PPC under the umbrella of SC. By doing so, we could really cover all areas of this vast topic. In fact, our work aims to list and provide essential tools and evidence necessary for health professionals to be able to satisfy the need for knowledge of the interlocutor(s), whether they are the audience of a TV program or the patients and their relatives within their own clinical practice. Of course, even our work is not without flaws, primarily the lack of quantitative analysis of how, as communication input varies, patient output may vary. In addition, experts in psychology or psycho-oncology were not involved to help us enrich the content of our review. Nonetheless, we hope that this endeavor opens new scenarios to scientific community, as to design new prospective clinical trials that aim to solve the underlined issues, firstly the vast heterogeneity and the lack of quantitative correlations between PPC and clinical outcome assessed in the reported studies.

Declarations

None

Ethics

Not Applicable

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Table 2
Oncological communication decalogue.

QUESTION	ANSWER
1) Why do we need a decalogue on oncological communication?	For oncological patients, effective communication with their physicians can **improve satisfaction, quality of life, adherence to treatments, and understanding**. Otherwise, poor communication can lead to patients' anxiety and depression, increased malpractice suits, and physicians' burnout (https://www.cancer, 2023a, 2023b).
2) What does "effective communication" mean?	Effective communication in oncology involves **acknowledging patient emotions, providing guidance, staying responsive, and enhancing trust and decision-making**. Since patients may vary in their preferences, as in their willingness (or even ability, in terms of medical literacy and/or numeracy) to receive in-depth prognostic details or to have a decisional role in their treatments, healthcare providers must adopt **tailored approaches** (https://www.cancer, 2023a, 2023b).
3) What are the so-called "communication models"?	**Communication models** serve as valuable problem-solving tools in oncology, guiding clinicians by outlining communication goals and needs. However, they may exert limited impact on patient outcomes, due to a possible mismatch between these abstract models and real-life patient-oncologist interactions. For this reason, we can find different models for the different situations that may arise within the various doctor-patient relationships (https://www.cancer, 2023a, 2023b).
4) What are the main communication models and tools?	• ***Shared Decision-making (SDM)*** emphasizes patient-clinician collaboration in decision-making. Lack of consensus on essential SDM behaviors, training methods, and the usefulness of apposite tools or devices hinder widespread integration (https://www.cancer, 2023a, 2023b). • ***Patient-Centered Communication*** focuses on six core functions of communication in cancer care: fostering healing relationships, exchanging information, responding to emotions, managing uncertainty, making decisions, and enabling patient self-management. Interventions based on this model showed improvements in communication behaviors but a limited impact on health-related outcomes (https://www.cancer, 2023a, 2023b). • **Other models**, explaining behavior change, highlight the interaction between emotions and cognition in decision-making and recognize communication's role in influencing patient decisions (https://www.cancer, 2023a, 2023b). • **Communication tools** rise to aid professionals in skill application, especially during training. Three prominent tools are *Ask-Tell-Ask*, *NURSE*, and *SPIKES*: *Ask-Tell-Ask* facilitates open dialogue by starting with a question, conveying information briefly, and confirming patient understanding; *NURSE* assists in managing emotions by addressing patient feelings through *Name*, *Understand*, *Respect*, *Support*, and *Explore*; *SPIKES* aids in delivering difficult news by organizing the process (*Setting*, *Perception*, *Invitation*, *Knowledge*, *Empathy*, and *Summary*) (Gilligan et al., 2017).

(*continued on next page*)

Table 2 (*continued*)

QUESTION	ANSWER
5) In which cases can differences arise in the way of approaching cancer patients?	• **At each visit**, since each patient has a unique personality. • **Discussing treatment** variables, options, and goals, since these preferences will vary according to the ideologies of individuals. • **Evaluating family involvement** in care, the dynamics of which vary considerably from culture to culture. • **In cases of minority patients**, when there are language barriers or in the presence of poor literacy or numeracy – all cases where it is mandatory to tailor our communication, to level out the differences between doctor and patient, and to have an effective relationship between the two parties. • **Discussing the costs of care** (a particularly relevant issue in all those nations with a highly privatized health system), since not everyone has the same financial means, or the same willingness to think in terms of cost-benefit ratio. The ASCO guidelines (Gilligan et al., 2017) will explore each of these aspects in more depth.
6) In all these contexts, how can the oncologist-patient relationship vary?	Patients seek information from clinicians about their illness, but emotional responses to cancer diagnosis can hinder information processing. Clinicians' responsiveness to patients' emotional reactions can improve communication. These emotional reactions may vary due to different factors, listed below (https://www.cancer, 2023a, 2023b): • **Demographic and cultural factors**: Variables such as age, gender, ethnicity, family structure, and socioeconomic status influence communication preferences and styles. Frameworks proposed the shift from the concept of *cultural competence* to *cultural humility*, for better patient-physician dynamics, since the former ensure the knowledge of different cultures, but the latter ensures the respect of the diversities. NIH's guidelines (https://www.cancer, 2023a, 2023b) depict some of the principal considerations based on relevant demographic factors. • **Health Literacy**: This factor influences the understanding of disease and treatment plans, almost independently (or, at least, in addition) to the previously shown demographic and cultural factors. To note, educational levels are not always a good indicator for health literacy. However, recommendations in this regard include plain language, limited information per interaction, "cultural relevance", and "teach-back strategies". • **Inequalities and discrepancies**: Greater providers' awareness of their implicit bias and structural racism is the bigger step to mitigate disparities. Strategies to address this issue involved patient-centered communication, clinical navigators, and language assistance services for patients speaking different languages. • **Spirituality and religion**: These serve as coping mechanisms for patients and caregivers; therefore, acknowledging and addressing spiritual and religious needs are important steps in cancer care.
7) How can these communication skills be acquired?	While **education in cancer communication** is deemed crucial, current oncology programs lack explicit communication skill sessions due to faculty limitations, with less focus on evaluating communication training for fellows compared to medical procedures. Nurse training programs exist but exhibit inconsistent application in practice. The methods for communication skills training have evolved, encompassing diverse approaches globally. Communication skills training in oncology should prioritize practical exercises and experiential learning over lectures, aiming to enhance self-awareness and emotional understanding; indeed, reflection exercises, role-play scenarios, and training emphasizing empathy and open questioning have shown improvement in clinician skills. However, optimal duration and efficacy in improving patient outcomes necessitate further exploration and standardization for better assessment (Gilligan et al., 2017; https://www.cancer, 2023a, 2023b).
8) Are there technologies that can foster this type of communication?	The concept of ***eHealth*** is an "emerging tool" in cancer care, encompassing various computer-based supports for patients and caregivers. Its goals include tailoring communication and information provided, remote monitoring and management, patient empowerment, and improving health-related behaviors. However, potential drawbacks include privacy concerns, technology barriers due to different digital literacy and economic capabilities, quality control, and increased demand on clinicians' time with the interpretation of the information found by the patients. An example of emerging technologies is the so-called ***Patient' Decision Aid*** (***PDA***), a specialized sub-class Clinical Decision Support Systems (CDSS) which is integrated with Electronic Health Records (EHR) and the latest international guidelines. PDAs are designed to assist patients during medical consultations, by enhancing their understanding of their health condition and facilitating informed decision-making regarding their clinical path. To do so, these tools employ a user-friendly and customized User Interface (UI) to present comprehensive and adjustable information, tailored to individual needs. However, as seen for training, while eHealth interventions show promise, current studies lack a robust theoretical framework and face challenges in standardization, scalability, and the evaluation of rapidly evolving technologies (Gilligan et al., 2017; https://www.cancer, 2023b; Olling et al., 2019; Yen et al., 2021).
9) What can patients and their families do to foster communication with their physicians?	Communication is pivotal in cancer care for patients and their families, fostering trust and aiding decision-making. Effective communication facilitates mutual understanding, treatment discussions, and slightly reduces the stress levels of clinicians, patients, and their families. However, cancer communication poses challenges for non-professionals, often prompting emotional suppression. Moreover, cultural preferences, such as communication styles or information delivery, impact patient-provider interactions; therefore, **it's pivotal for patients and their families to inform their physicians about their preferred**

(*continued on next page*)

Table 2 (*continued*)

QUESTION	ANSWER
	way to communicate. Understanding and addressing these different communication needs are integral to delivering and receiving effective cancer care (Gilligan et al., 2017).
10) Where is the boundary between the need for good oncological communication and the need for psychological support?	One of the greatest challenges for a physician engaging in oncology communication is understanding **where to draw the line between a patient's normal and abnormal psychological reaction to their illness** (Lang-Rollin and Berberich, 2018; https://www.hematologyandoncology, 2023; Carlson and Bultz, 2003). Adjustment disorders, anxiety, and depressive disorders are common psychological issues within cancer patients, varying in prevalence across different cancer types, patient demographics, and diagnostic criteria. Around 20 % of cancer patients might require psychiatric intervention for major depression/anxiety during their cancer journey, while another 15 % may benefit from psychological support. The integration of **psycho-oncological screening tools** aims to recognize patients' distress early, proactively manage psychosocial problems, and integrate psychological care seamlessly within routine oncology treatment. Distress screening is, thus, a crucial component, often using instruments like the "distress thermometer" or a short list screening for various practical, emotional, and spiritual concerns, as recommended by the National Comprehensive Cancer Network (NCCN). These screenings should be followed by psychoeducational measures, i.e., informing patients about available services and evaluating their desire for psychosocial support. The screenings should prompt a more in-depth clinical assessment and specific treatment for identified problems, all guided by specialists. Psycho-oncology programs, like those found in the US, UK, Australia, and Canada, have adopted routine psychological screening to address distress levels early and offer timely interventions, often through eHealth services. However, while evidence shows that such screenings improve outcomes when patients accept referrals, some dispute the overall benefits. To delve into these concepts, the NCCN has a guideline for physicians (https://www.nccn, 2023a) and one for patients (https://www.nccn, 2023b) regarding the management of distress caused by oncological diseases.

CRediT authorship contribution statement

A.Galvano, Conceptualization; Study design; Data acquisition, analysis & interpretation; Draft writing & review; ***A.Gottardo***, Conceptualization; Study design; Data acquisition, analysis & interpretation; Draft writing & review; ***VG***, Study design; Data acquisition, analysis & interpretation; Draft writing & review; ***DF***, Data analysis & interpretation; Draft review; ***LRC***, Data analysis & interpretation; Draft review; ***CP***, Data analysis & interpretation; Draft review; ***TDBR***, Data acquisition & analysis; Draft writing; ***EDG***, Data acquisition & analysis; Draft writing; ***GI***, Data acquisition & analysis; Draft writing; ***UR***, Data acquisition & analysis; Draft writing; ***FI***, Data acquisition & analysis; Draft writing; ***AP***, Data analysis & interpretation; Draft review; ***CB***, Data acquisition & analysis; Draft writing; ***M.Bono***, Data acquisition & analysis; Draft writing; ***VB***, Data analysis & interpretation; Draft review; ***LI***, Data analysis & interpretation; Draft review; ***GB***, Data analysis & interpretation; Draft review; ***SC***, Conceptualization; Data interpretation; Draft review; ***M.Boldrini***, Conceptualization; Data interpretation; Draft writing & review; ***RB***, Conceptualization; Data interpretation; Draft review; ***AR***, Corresponding Author; Conceptualization; Data interpretation; Draft review;

All authors had full access to all study data and took responsibility for their integrity and for the accuracy of the data analysis. All authors read and approved the final manuscript.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used *ChatGPT* to *make the literature draft reports* and to *shorten and restyle the main text*. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the content of the publication.

Declaration of Competing Interest

No conflict

Acknowledgments

The authors thank Dr. Silvia Rotondo and Dr. Marzia D'Alessandro for their contribution to paper translation. A. Gottardo, TDBR, and EDG contributed to this paper under the "*Experimental Oncology and Surgery*" Ph.D. program (University of Palermo), while UR under the "*Precision Medicine*" Ph.D. program (University of Palermo). Graphical abstract was made by Authors with *BioRender*.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.critrevonc.2024.104531.

References

https://cordis.europa.eu/article/id/442429-science-communication-empowering-citizens-in-the-public-discussion-of-science/it (accessed between 25th of October and 19th of December 2023).
https://magazine.cisp.unipi.it/pandemia-e-divulgazione-scientifica/ (accessed between 25th of October and 19th of December 2023).
Laugksch, R.C., 2000. Scientific Literacy: A Conceptual Overview. John Wiley & Sons, Inc.
https://www.quotidianosanita.it/scienza-e-farmaci/articolo.php?articolo_id=104428 (accessed between 25th of October and 19th of December 2023).
https://www.epicentro.iss.it/hbsc/indagine-2022 (accessed between 25th of October and 19th of December 2023).
https://www.metodologiedidattiche.it/2017/12/09/stem/ (accessed between 25th of October and 19th of December 2023).
G. Polizzi; Metodi scientifici; Enciclopedia dei ragazzi – Treccani (2006).
L. Tremolada; Gli italiani hanno fiducia nella scienza? Ecco cosa misura lo State of science index; Info Data – Il Sole 24 Ore (2022).
https://www.3m.com/3M/en_US/3m-forward-us/?utm_medium=redirect&utm_source=vanity-url&utm_campaign=3M.com/scienceindex (accessed between 25th of October and 19th of December 2023).
N.Di Roberto; Epidemia di disinformazione; Almanacco della scienza – Consiglio Nazionale delle Ricerche (2022).
Johnson, S.B., et al., 2022. Cancer Misinformation and Harmful Information on Facebook and Other Social Media: A Brief Report. J. Natl. Cancer Inst. 114 (7), 1036–1039. https://doi.org/10.1093/jnci/djab141.
Chevalier, A., et al., 2015. Strategy and accuracy during information search on the Web: Effects of age and complexity of the search questions (December, Pages). Comput. Hum. Behav. 53, 305–315. https://doi.org/10.1016/j.chb.2015.07.017.
https://www.corriere.it/salute/23_novembre_01/come-capire-se-sito-che-tratta-argomenti-salute-attendibile-27478bf4-1cd2-11ee-8345-1434d5233ba7.shtml?refresh_ce (accessed between 25th of October and 19th of December 2023).
Perra, M., Brinkman, T., 2021. Seeing science: using graphics to communicate research. Ecosphere 12 (10), e03786.
Hutchins, J.A., 2020. Tailoring scientific communications for audience and research narrative. Curr. Protoc. Essent. Lab. Tech. 20, e40.
https://www.frameworksinstitute.org/article/order-matters/ (accessed between 25th of October and 19th of December 2023).

https://www.uab.edu/ccts/news-events/10-tips-to-successful-science-communication (accessed between 25th of October and 19th of December 2023).
Tran, L.U., 2008. Dialogue in education. ISSN 1824 – 2049 J. Sci. Commun. ISSN 1824 – 2049.
Dahm, R., et al., 2019. Interdisciplinary Communication Needs to Become a Core Scientific Skill. BioEssays 41 (9).
M. Rovelli; I nuovi strumenti della divulgazione scientifica, dai social ai podcast: «Così accendiamo lampadine di curiosità»; Corriere Della Sera – Tecnologia (2023).
Hurst, N., 2016. To clickbait or not to clickbait?: an examination of clickbait headline effects on source credibility. Univ. Mo. -Columbia – Open. Thesis.
Gilligan, T., et al., 2017. Patient-Clinician Communication: American Society of Clinical Oncology Consensus Guideline. November 01 J. Clin. Oncol. 35 (31), 3618–3632. https://doi.org/10.1200/JCO.2017.75.2311.
https://www.cancer.gov/about-cancer/coping/adjusting-to-cancer/communication-pdq (accessed between 25th of October and 19th of December 2023a).
https://www.cancer.gov/about-cancer/coping/adjusting-to-cancer/communication-hp-pdq (accessed between 25th of October and 19th of December 2023b).
Li, J., et al., 2020. Communication Needs of Cancer Patients and/or Caregivers: A Critical Literature Review. May 7 J. Oncol. 2020, 7432849. https://doi.org/10.1155/2020/7432849.
LeBlanc, T.W., et al., 2019. Prognostication and Communication in Oncology (March 25 J. Oncol. Pract.. https://doi.org/10.1200/JOP.18.00647.
Sisk, B.A., et al., 2018. How Should We Enhance the Process and Purpose of Prognostic Communication in Oncology? AMA J. Ethics 20 (8), E757–E765. https://doi.org/10.1001/amajethics.2018.757.
Bouleuc, C., et al., 2021. A Question Prompt List for Advanced Cancer Patients Promoting Advance Care Planning: A French Randomized Trial. J. Pain. Symptom Manag. 61 (2), 331–341.e8. https://doi.org/10.1016/j.jpainsymman.2020.07.026.
Chawla, N., Arora, N.K., 2013. Why do some patients prefer to leave decisions up to the doctor: lack of self-efficacy or a matter of trust? J. Cancer Surviv 7, 592–601. https://doi.org/10.1007/s11764-013-0298-2.
Cheng, Y.-H., et al., 2019. The training in SHARE communication course by physicians increases the signing of do-not-resuscitate orders for critical patients in the emergency room (cross-sectional study). Int Surg. J. 68, 20–26. https://doi.org/10.1016/j.ijsu.2019.06.005.
Chiang, T.-Y., et al., 2015. Factors related to treatment refusal in Taiwanese cancer patients. Asian Pac. J. Cancer Prev. 16 (8), 3153–3157. https://doi.org/10.7314/apjcp.2015.16.8.3153.
Currier, J., et al., 2022. A Coordinated Approach to Implementing Low-Dose CT Lung Cancer Screening in a Rural Community Hospital. J. Am. Coll. Radio. 19 (6), 757–768. https://doi.org/10.1016/j.jacr.2022.02.041.
Leiter, R.E., et al., 2018. Fidelity and Feasibility of a Brief Emergency Department Intervention to Empower Adults With Serious Illness to Initiate Advance Care Planning Conversations. J. Pain. Symptom Manag. 56 (6), 878–885. https://doi.org/10.1016/j.jpainsymman.2018.09.003.
Mahmoudi, E., et al., 2017. Association of a Policy Mandating Physician-Patient Communication With Racial/Ethnic Disparities in Postmastectomy Breast Reconstruction. JAMA Surg. 1 152 (8), 775–783. https://doi.org/10.1001/jamasurg.2017.0921.
Spiers, S., et al., 2018. Modelling attrition and nonparticipation in a longitudinal study of prostate cancer. BMC Med Res Method. 20 18 (1), 60. https://doi.org/10.1186/s12874-018-0518-6.
van der Velden, N.C.A., et al., 2024. Effects of Prognostic Communication Strategies on Prognostic Perceptions, Treatment Decisions and End-Of-Life Anticipation in Advanced Cancer: An Experimental Study among Analogue Patients. J. Pain. Symptom Manag. 67 (6), 478–489. https://doi.org/10.1016/j.jpainsymman.2024.02.563.
Wang, T.-J., et al., 2021. Efficacy of a decision support intervention for reducing decisional conflict in patients with elevated serum prostate-specific antigen: A randomized controlled trial. Eur. J. Oncol. Nurs. 50, 101865. https://doi.org/10.1016/j.ejon.2020.101865.
Yeoh, Z.-Y., et al., 2018. Feasibility of Patient Navigation to Improve Breast Cancer Care in Malaysia. J. Glob. Oncol. (4), 1–13. https://doi.org/10.1200/JGO.17.00229.
Chaturvedi, S.K., et al., 2014. Communication in cancer care: psycho-social, interactional, and cultural issues. A general overview and the example of India. Front. Psychol. 5, 1332. https://doi.org/10.3389/fpsyg.2014.01332.
https://ascopost.com/issues/november-25-2017/asco-releases-guideline-to-help-oncologists-improve-communication-with-patients-and-their-own-well-being/ (accessed between 25th of October and 19th of December 2023).
Olling, K., et al., 2019. The impact of a patient decision aid on shared decision-making behaviour in oncology care and pulmonary medicine—A field study based on real-life observations. J. Eval. Clin. Pr. 25, 1121–1130. https://doi.org/10.1111/jep.13196.
Yen, R.W., et al., 2021. A systematic review and meta-analysis of patient decision aids for disadvantaged populations: update from the International Patient Decision Aid Standards (IDPAS) (Oct). Med Decis. Mak. 41 (7), 870–896. https://doi.org/10.1177/0272989X211020317.
Lang-Rollin, I., Berberich, G., 2018. Psycho-oncology (Mar). Dialog-. Clin. Neurosci. 20 (1), 13–22. https://doi.org/10.31887/DCNS.2018.20.1/ilangrollin.
https://www.hematologyandoncology.net/archives/december-2016/the-management-of-psychological-issues-in-oncology/ (accessed between 25th of October and 19th of December 2023).
Carlson, L.E., Bultz, B.D., 2003. BD; Benefits of psychosocial oncology care: improved quality of life and medical cost offset. Apr 17 Health Qual. Life Outcomes 1, 8. https://doi.org/10.1186/1477-7525-1-8.
https://www.nccn.org/professionals/physician_gls/pdf/distress.pdf (accessed between 25th of October and 19th of December 2023a).
https://www.nccn.org/patients/guidelines/content/PDF/distress-patient.pdf (accessed between 25th of October and 19th of December 2023b).

A.Galvano: Medical oncologist, Associate Professor and Ph.D. in "Experimental Oncology and Surgery" course at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

A.Gottardo: Medical biotechnologist and Ph.D. student of the "Experimental Oncology and Surgery" course at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

VG: Medical oncologist, research fellow, and Ph.D. in "Experimental Oncology and Surgery" course at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

DF: Biologist Executive, research fellow, and Ph.D. in "Molecular and Cellular Oncopathology" at the "Sicilian Regional Center for the Prevention, Diagnosis and Treatment of Rare and Heredo-Familial Tumors" of the Section of Medical Oncology of University of Palermo (IT).

LRC: Biologist, medical oncologist, research fellow, and Ph.D. in "Cellular and Molecular Oncophatology" at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

CP: Specialist in urology and andrology, Associate Professor of urology, member of the Academic Senate at the University of Palermo (IT). He directs the International School of Urology and Nephrology at the Ettore Majorana Center in Erice. He is a member of numerous national and international scientific societies.

TDBR: Resident medical oncologist and Ph.D. student of the "Experimental Oncology and Surgery" course at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

EDG: Medical biotechnologist and Ph.D. student of the "Experimental Oncology and Surgery" course at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

GI: Resident Medical Oncologist at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

UR: Resident medical oncologist and Ph.D. student of the "Precision Medicine" course at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

FI: Medical oncologist at the Italian National Society Security Institute (INPS), Palermo (IT).

AP: Molecular biologist at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

CB: Biologist and Ph.D. at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

M.Bono: Molecular biologist at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

VB: Associate Professor of medical oncology and at the Department of Biomedicine, Neuroscience and Advanced Diagnostic (Bi.N.D.), University of Palermo (IT). From July 2008 to July 2011, she has been an Adjunct Assistant Professor and since August 2011 is Adjunct Associate Professor at Temple University's College of Science and Technology, Philadelphia (USA). Over the last few years, she has been implicated in projects of clinical oncology research aimed at identifying prognostic biomarkers and of treatment response. In this context, she has been concerned with the molecular genetics of sporadic, hereditary and familial tumors. She is the author of more than 200 publications in top-rated cancer journals.

LI: Medical oncologist and Assistant Professor at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

GB: Medical oncologist and Associate Professor at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT).

SC: Director of the UOC Medical Oncology and Breast Unit of the Brindisi (IT) Local Health Authority (ASL). He is a member of major international scientific societies, president of AIOM foundation and past president of AIOM.

M.Boldrini: Pharmacist and professional journalist, co-founder of "Intermedia", a news agency specializing in the field of health. For more than 20 years he has been involved in science dissemination following major congresses around the world. He is press office chief of SIMG, the FIMP, SIR, SIUrO, and AIOM. He is director of communications for the "Together Against Cancer" Foundation.

RB: Full Professor of medical oncology at Marche Polytechnic University of Ancona (IT). She is member of national board of AIOM. She is also an active member of the main scientific oncological groups, such as ASCO, ESMO, and COMU.

AR: Full Professor of medical oncology, coordinator of the national Ph.D. course in "Precision Medicine" at the Department of Precision Medicine in Medical, Surgical and Critical Care (Me.Pre.C.C.), University of Palermo (IT), and Adjunct Full Professor at Temple University's, Philadelphia (USA). Recently, he has been the recipient of numerous professional accolades, including Visiting Professor, Honorary Professor and Doctor Honoris Causa distinction from the Peruvian Ricardo Palma University. In 2019 he also received the prestigious NIAF Award for Ethics and creativity in medical research in Washington (USA). He is president of COMU an active member of the main scientific oncological groups as ASCO, ESMO, and ISBL.