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How do cancer research scientists deal with machines and consumables? Exploring research ethics from an inductive ethnographic perspective

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This paper started from an inductive ethnography conducted within a cancer research lab in Belgium. The primary objective was to explore how researchers make decisions and rationalize their scientific practices. Through data collected from participant observation, interviews, and analysis of research protocols, the study exposes serious knowledge gaps that compromise research ethics. Specifically, the findings reveal the scientists' need for more understanding of the validity of their lab machines and the readymade consumables procured from external providers. Moreover, without questioning this dependency, our participants (scientists) rely heavily on machines and consumables for almost all their research protocols. The findings suggest that cancer researchers place unjustifiable trust in the lab's machines and the external providers' reliability; this compromises the following three fundamental ethical principles: research integrity, responsible conduct, and the responsibility of using resources and technologies.

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Introduction

Several social scientists and communication scholars have conducted ethnographic studies in the natural habitat of experimental scientists, such as research labs, to provide authentic insights into scientific knowledge construction. How knowledge emerges through the social processes and interactions within research communities is an intriguing question, especially when we view knowledge as a communication construction (Mnasri and Papakonstantinidis, 2023) rather than a product in human brains. Unlike essentialists, who focus on the underlying facts that shape human thoughts, social constructionists focus on interactions that shape knowledge (Schudson and Gelman, 2023). Following this interest, Latour and Woolgar (1979) were among the first social scientists who observed research labs and explored the social and cultural factors that shape the production of scientific "facts" (i.e., knowledge). They emphasized the importance of observing scientists in everyday interactions to understand scientific knowledge construction. Latour (1987) refuted the traditional notion of scientific knowledge as a purely objective and detached pursuit. Latour (2005) and Callon (1986), among others, propose the "actor-network theory" (ANT) that explores the importance of understanding the network of actors. To do so, they emphasize the need to trace the whole network of scientists, instruments, materials, and institutions, as well as the complex interactions between these elements and their influence on the production of scientific knowledge. Using ANT, social scientists can explore knowledge construction on the go (in the making), i.e., how knowledge builds up through interactions. From this perspective, ANT offers some visualization of knowledge construction, which remains intangible.

The laboratory environment is crucial for scientific research, innovation, and knowledge construction. As researchers delve into cutting-edge research and push the boundaries of knowledge, several ethical implications and challenges may arise and affect their decision-making (Resnik, 2015), necessitating careful observation, consideration, and evaluation. Accordingly, researchers should be aware of possible ethical issues during laboratory experiments and research (Nuffield Council on Bioethics, 2012; O'Mathúna, 2007; Sugarman and Bredenoord, 2020). As an interdisciplinary field, bioethics is pivotal in addressing the ethical aspects of scientific research and knowledge construction. It encompasses various principles and frameworks that guide ethical decision-making in research practices, including respect for autonomy, beneficence, non-maleficence, and justice (Beauchamp and Childress, 2019). However, despite established research ethical principles, the laboratory environment presents unique challenges that require continuous attention and adaptation. One critical ethical implication in the laboratory setting relates to the responsible and ethical use of machines and consumables.

Closely observing the practices and interactions within a cancer research lab in Belgium, this paper aims to examine the ethical implications of scientific knowledge construction. In effect, the main objective of this paper is to advocate for responsible and reflective scientific practices from a transdisciplinary stance. Accordingly, the paper adopts an inductive approach within the framework of ethnographic studies as applied to experimental sciences. Initially, the study aimed to provide a detailed and nuanced account of the daily activities and interactions within the cancer research lab. The study provides insights into the research ethical implications embedded in the scientists' practices and the construction of the lab's scientific knowledge. However, the analysis responded to the ethical issues from empirical data and findings. Specifically, trust as a fundamental ethical principle compels attention, prompting a central focus on addressing it. This study underscores the suitability of ethnographic research and participant observation in shedding light on previously unexamined aspects of scientific practices. Therefore, we highlight the importance of taking a holistic approach to understanding science in the making, considering the technical and methodological aspects and the transdisciplinary stances to comprehend such multi-faceted matters better.

Trust as fundamental research ethical principle

Ethical principles are crucial in guiding ethical decision-making and responsible conduct of research. Trust emerges as a fundamental ethical principle underpinning the integrity and credibility of the entire process. Since our data analysis explores how lab scientists build trust with lab machines, the following section sheds light on trust's role in communicating knowledge to the public. Hardin (2002) worked on trust in scientific research. He made significant contributions to understanding how trust develops in scientific research. Hardin posited that trust should come as a rational choice rather than merely an emotional or irrational belief. Trust in research is a strategic decision based on individuals' assessments of the credibility and reliability of researchers, institutions, machines, and processes. He emphasized the importance of well-designed institutional structures and mechanisms that promote trust, such as transparent regulations, accountability, and rigorous peer review processes. Hardin also recognized the role of social norms in shaping trust within the research community and highlighted how trust facilitates collaboration, knowledge sharing, and the advancement of scientific research. He acknowledged the significance of public trust in research, emphasizing the need to establish and maintain trust with the broader public to ensure scientific findings' acceptance and meaningful application.

In the health care context, several declarations (i.e., European Code of Conduct for Research Integrity 2017; Hong Kong Principles 2019; Montreal Statement 2013; Singapore Statement 2010) identified critical ethical principles and outlined the key components of trustworthy research and principles of research integrity. The three fundamental ethical principles identified in the European Code of Conduct for Research Integrity (2017), Hong Kong Principles (2019), Montreal Statement (2013), and Second World Conferences on Research Integrity (2010) are: research integrity, responsible conduct of research, and responsible use of resources and technologies. The first principle, "research integrity," emphasizes the importance of honesty, accuracy, and transparency in scientific research. Researchers and scientists should conduct their research and experiments with integrity that ensures the reliability of their findings. The second principle, "responsible conduct of research," corresponds to the imperative of conducting work in a responsible and accountable manner. This principle entails that researchers adhere to ethical guidelines and regulations, accurately report methods and results, and address conflicts of interest. Finally, the "responsible use of resources and technologies" principle, including funding, laboratory equipment, biological materials, and consumables, is particularly pertinent to any lab environment. Researchers and scientists should use lab resources efficiently and in a manner that benefits scientific progress and the public good.

The central pillar of the three principles mentioned above is trust. Trust serves as the glue that binds scientists, researchers, participants, and the public together, ensuring the validity and ethicality of scientific research. However, scientific research can question trust regarding the relationship between researchers and participants in data analysis, reporting, and communicating scientific knowledge to the public.

Additionally, many articles have been dedicated to the topic of research integrity, covering areas such as the impact of hyper-competitiveness and inadequate training on research quality, the uncritical and ineffective use of metrics in evaluating researchers, and the presence of systematic biases in peer review and publication (Mejlgaard et al., 2020). Mark Yarborough (2014, 2021) examined the question: Is research routinely conducted ethically? He found that researchers place excessive reliance on professional norms, peer review, research regulations, research integrity programs, and mandatory training in responsible research conduct to establish the trustworthiness of the research community. Consequently, research teams and institutions must implement additional safeguards if they genuinely aim to warrant the public trust they seek when conducting scientific research. This situation reiterates the challenge of ensuring researchers and research institutions adopt a more mindful approach when addressing research improvement and integrity.

Efforts to incorporate ethics into lab research must be actively pursued, implemented, and substantiated by developing appropriate strategies (Bærøe et al., 2022; Zwart and Ter Meulen, 2019). Accordingly, Buedo et al. (2023) explored the ethical implications and challenges that researchers who work in biotechnology laboratories may encounter. The authors provided a concrete strategy to promote the integration of research ethics with laboratory practice and to strengthen responsibility in laboratory research. The aim of the proposed strategy was (i) to integrate ethics into laboratory research to identify bioethical problems early, (ii) to create input for normative evaluation and (iii) to establish a research integrity environment. This strategy hinges on three theoretical and practical approaches: (i) Ethics Parallel Research, (ii) Social Labs, and (iii) the Responsible Research and Innovation framework. Ethics Parallel Research (EPR) serves the purpose of ethically guiding the development of biotechnology throughout the process while providing normative evaluation. Social Labs are recognized as practical tools that integrate and drive social change within specific contexts, emphasizing a clear and defined focus. These labs, designed to operate in real-world settings, prioritize practical applications rather than abstract concepts. Responsible Research and Innovation (RRI) offers strategies to proactively anticipate, evaluate, and enhance societal engagement while identifying potential implications (Burget et al., 2017). The overarching goal of the RRI framework is to foster inclusivity and sustainability within the research process, promoting a more comprehensive and socially conscious approach.

Buedo et al. (2023) added that focus group meetings facilitated proactive discussions and fostered the exchange of experiences, uncertainties, and ideas within the research process, specifically for those working in laboratory settings. The assessment of this experience revealed several benefits of integrating ethics within research consortiums, including researchers' commitment to ethics in their work methods and research objectives, the actions taken following the intervention, and the emergence of supplementary activities resulting from the collaborative generation of ideas and reflections. However, the authors revealed that despite numerous ethics guidelines and increased awareness of research ethics, effectively incorporating them into day-to-day research practices, particularly in laboratory settings, poses a severe challenge (Laas et al., 2022; Resnik et al., (2023)).

The objective of the current study is to explore the role of trust between lab scientists and machines and how this relationship unfolds to the public. In this sense, Besley et al. (2018) claim that scientific trust extends beyond the scientific community to the general public. Effective science communication is crucial in building public trust in research outcomes. In addition, transparent communication about methods, results, and potential implications fosters understanding and confidence in scientific endeavors. On the other hand, several risks may emerge if scientists fail to justify their trust in lab machines. For instance, it may affect the credibility of scientific institutions and organizations and erode public confidence in scientific findings and the scientific community.

Methodology

This paper adopts an ethnographic research design within an oncology research lab to investigate the ethical implications of the scientists' practices as represented in their knowledge construction. The cancer lab comprises ten postdoctoral and doctoral researchers, technicians, and a principal investigator with a medical background and prior experience at leading institutions. The principal investigator had served as a Postdoctoral fellow and Research Associate at a prominent medical institution in Boston. The lab has 255 publications, owns several patents, and achieved an H index of 81 in 2022. With this strong record of publications, the lab is well-regarded in the field of oncology. It conducts fundamental cancer research (i.e., on cells only, not humans). The data comprises 18 months of direct participant observation, individual and collective interviews, and detailed field notes. The interviews aimed to gather information on how scientists utilize machines and consumables. The first author conducted individual interviews with each participant and a collective interview 6 months later. The individual interviews were analyzed in a synchronic manner, while the collective interview was analyzed diachronically. The data collected through participant observation and interviews were analyzed using qualitative and inductive approaches. The systematic analysis of the data rests on the following ethical principles that are relevant to the laboratory environment: research integrity, responsible conduct of research, and responsible use of resources. Therefore, the study addresses the following research question and its sub-question:

RQ1: How do researchers use the lab machines and consumables in their research practices?

RQ1a: What are the ethical implications of such use of machines and consumables?

To answer the research questions, we designed a semi-structured interview. The first author interviewed each participant. Six months later, he asked the same questions in a collective interview to explore discrepancies and contradictions. The interview comprises five questions: "1) What processes do you typically follow to verify your results?" 2) "Do you trust machines?" 3) "Do you trust products from other companies?" 4) "What is the proportion of operations performed by other parties in your experiments?" 5) "Can you provide a diagram illustrating the different stages or operations in your current research?"

We coded the interviews using the Jefferson system of transcription notation, detailed in Atkinson and Heritage (1984). The names of the participants have been changed into the following pseudonyms to protect their identity and privacy:

Paul: The lab director/Principal Investigator
Stephan, Daniel, Brian, and Dilara: Postdoctoral researchers
Cédric and Gaelle: PhD researchers
Dalila and Marie: Technicians
Joane: a master's student

The lab has numerous machines; some are simple, and some are very sophisticated. They range from freezers, hoods, incubators, centrifuges, and the like to smaller tools used in what they call western blotting and the like. In addition to machines, the lab members consume products that range from substances such as medium, trypsin, powders, gels, and the like, to small tools such as pipettes, plates, tips, filters, and many more. These consumables have to be certified, and they have to be purchased from a reliable provider because their chemical composition may influence the cancer cells and, therefore, skew the research results. The consumption of these products is ongoing every second, all around the clock. The lab members are constantly consuming without stopping.

Under the current research design, research operations are only feasible using these products.

Data analysis and discussion

Trusting machines and implications for machine validity. The lab researchers unanimously said they trust machines almost the same way. The researchers' responses varied when asked how they ascertained the lab machines' ability to measure what they initially intended. Some participants admitted to not knowing, while others were able to explain how the machines work, indicating a better understanding of their accuracy. Certain participants minimized the need for such considerations, implying a lack of interest or time to investigate machine performance's "philosophical" aspects. In this sense, researchers expressed trust in the machines they utilize, asserting that they perform the intended functions correctly and provide accurate measurements. However, their understanding of the machines' functionality differed. Some participants believed that the machines were appropriately designed and that they functioned as intended. In contrast, others relied on the reputation of the machine providers or the fact that others had already used the machines to validate their trust. In line with Hardin's (2002) conception of trust outlined in the previous paragraph, all the researchers' responses lack rational justification for machine validity.

For instance, Cédric responded to the question *"Do you trust machines?"* determinedly by saying, "Yeah." When I asked him, "Is it like you have to trust them, or you need to trust them?" he confirmed his position: "no, they are designed to do what they are doing." As a doctoral researcher, Cédric seems focused on his research proposal and is not yet well positioned to rethink the machines' validity.

Paul- the principal investigator- said right from the beginning that he had to trust machines, hence acknowledging that it is a matter of obligation rather than a choice. I explained to Paul that what I meant by the question is whether he is sure that the machine measures what he (as a biologist) wants it to measure, not just that the machine runs well or is well calibrated. He replied: "Yes". When I explained my idea by saying that machines can be consistent and well-calibrated, but they may not in reality measure what we want to measure, he said:

I don't ask myself these kind of questions (.) I'm I consider that is being measured is uh reflects the reality (.) I don't doubt the except if again we have obtained ten times the same thing and the eleventh time we do the experiments we have u:h we have uh bizarre behavior than we could start to check whether is the machine is working properly but we do the maintenance of the machine in order to: to get them: uh as uh as efficient as possible (.) this is uh usually checked for the machine why you have them the highest risk of uh of problems this is checked by companies uh who knows the machine better than we do and who come to validate them using specific QC protocols or quality control protocols (.) so we are prone to believe (.) the machine.

After I explained again to Paul, he almost repeated the same idea: basically that they buy from highly reputable providers and that the machines "have been validated by others uh (.) so uh we have reference on what we should get with ourselves". Paul, who had already said that he does not ask himself such questions, now told me that he does not purchase black boxes, a term which I did not use myself:

We discuss with colleagues already using the machines so we make our minds in order to (.) finally buy the machine which (.) for which we are convinced that it does measure what we (.) u::h want to s to be measured and then it's a real it does truly reflect the parameter we we uh which is the one to investigate so we uh uh it's not like we we're dealing with black box we're dealing with machine which which are uh which have been validated by by others uh (.).

Joanne did almost as Paul and Cédric, acknowledging that she is not proficient in these areas. She said that she trusted machines because others also do: "Because I don't, I don't really know u::h machines and stuff like that but u::h if it is used by everybody like I have to trust them ((laughter))." When I tried to explain more, she interrupted me by saying: "[it's not stupid people who're making those machines.]" Then again, Joanne insisted that "yes they must produce something it's like it's not like u:h for example if you use a ma machine to check the concentration and stuff like that it's not a stupid thing (.) it's correct."

Thus, all the researchers described machines as reliable tools that consistently produce accurate results without recognizing the need for further examination of machine validity. Several participants mentioned that they rely on the views and expertize of their peers or experienced individuals who have used the machines to make informed decisions. They trust these individuals' knowledge and believe their recommendations would ensure accurate measurements. In contrast, some participants did not consider that machines may not measure what they intended, assuming that the manufacturers or service providers would address potential problems. Additionally, some participants exhibited a simplistic view of knowledge and assumed that answers to complex questions regarding machine accuracy could be easily obtained through documents or by consulting the right person. They may need to fully grasp the complexity of determining whether the machines truly measure what researchers intend to measure.

For example, during the collective interview, the first author mentioned a specific machine—the *photo spectrometer*- and asked what they knew about how it works. They said they do know and mentioned that it is a matter of different filters and emissions of light that interact with the fluorescent liquid they put on cells before inserting them into the machine. When he asked them to describe how the machine responds to the compounds (the liquid) validly, they described the machine's technique. Again, they should have noticed the technique's validity in measuring what they intend to assess (in this case, the density, absorbance or fluorescence of any protein they want to detect). He restated the concern by saying: "This is what I'm saying (.) the machine may be consistent (.) every time you give it this dose it will give this (.) and then you give a higher dose it will give you that (.) and in terms of graphs and colors and shapes it's consistent no problem (.) but how do you know that it is measuring what you want to measure?". Here Gaelle responded to the concern. She said: "because if you put water, for example, it will not u:h measure." Everyone seemed to enjoy this idea and supported it one after the other. However, the first author responded that while the machine may work with cells and not with water, it may not measure the specific aspect of the cell that the scientists target, but rather a different thing. At this point, Stephan's volume dropped significantly, admitting that the machine may measure other things: "↓ Maybe like contamination or something." This case shows that the researchers are building their research based on findings from machines they use as black boxes, assuming that they are doing what they want.

Trusting consumables and the associated risks. The lab members consume products ranging from medium, trypsin, powders, gels, and the like, to small tools such as pipettes, plates, tips, filters, and many more. These consumables have to be certified, and they have to be purchased from a reliable provider because their chemical composition may influence the cancer cells and, therefore, skew the research results. The lab members are constantly consuming without stopping. Following the current research design, research operations are only feasible using these products.

Paul first responded to the question: "Do you trust the products that you purchase from providers?" by saying that he trusts providers because it is easy for him to check if the needed protein is in the product that they purchase:

uh uff (.) again we (.) they are products for which it's quite easy to see whether it works or not (.) if you take an antibody (.) u:h it's easy for us to see whether it works or not (.) u:h you do the: the experiments (.) you try to detect a protein (.) you know (.) that protein is there or is not there (.) and you know at which size and some characteristic of the protein so (.) if the antibody does not recognize the protein then you know that the antibody does not work (.) u::h having done this kind of excerce:::: exercise several times we know that there are company which are not trustable (.) we know that everybody knows that in in science that if you buy an antibody from a company called ((company name removed)) u:h you have uh much less chance than with any other type of companies that the antibody will work (.) so they are less uh reliable.

I then told him that he only mentioned a case in which he could check and asked him if they could check if the product (a substance) would contain a molecule. At this level, he said that they are not and that they would completely blind themselves: "Yeah, there you are (.) you are blinded (.) you are acting as uh as uh being just prone to believe that uh what you are using is uh doing what you what it is described to do". Paul now realizes that "trust" can be about other scenarios, such as the one I mentioned, and is not limited to the case he mentioned. Paul's last account illustrates that their trust is not scientifically based and, therefore, represents a considerable threat to their experiments' validity. I wanted to make sure that this condition is also applicable to other labs in the world—at least from his point of view- so I said: "and the issue is that that's (.) consumables are used everywhere in the world it's not only in this lab so may be if there is a mistake or a problem it would be everywhere so you wouldn't know (.) nobody would figure it out". Paul confirmed my statement, by saying: "clearly (.)".

When I asked Cédric how much of purchased products he uses, he said, "Everything (.) almost". I asked him to draw me a diagram where he would mention all his current research steps, stating the ones provided and those prepared in the lab. He did so and then confirmed his previous statement again: "Everything is coming from different stuff […] Yeah, everything". I then asked him to account for the situation of depending on external providers; he said that it is a good situation because in that way, if labs from all over the world purchase from the same provider, then they can be sure that they are using the same products:

For me it's (.) can be a good thing like the medium (.) it's a really good thing (.) because that means that everyone in u::h the world (.) can use the same media that you are using (.) because if they just buy from the same provider then you buy it from (.) then they are sure they get the same (.) the same medium that you are getting.

Joanne's rationale was almost identical to Cédric; she said, "Uhm yes (.) I have to trust them otherwise ((laughter))." When I told her if the providers would alter the purchased products, would she be able to know, she replied: "I won't. I won't know about that (.) but you have to use it", hence confirming that she is rather obliged to trust, because she has no more options.

Daniel first said that only 30% of the products they use were purchased readymade. While he was drawing the diagram, he realized that it was much more than that, so he kept saying: "A lot of providers ((laughter)) even in this simple u::h experiment," then "ok (.) ok so they are quite a lot ((laughter))". When I asked him if he only discovered this situation now, he said: "Yeah (.) u:hm never thought about that but". Unlike his colleagues, Daniel realized how much they purchase readymade only after drawing the diagram. When I asked him for the first time to account for the situation of depending on providers, he said: "Of course but u:h I hope we can trust otherwise (.) this would change a lot."

Daniel then confirmed that they do not check after providers and that the results would shift if the products are not as described. Then when I asked him again, he said: "No for me it's (.) it's fine because u:h (.) they gi:ve they give us information about the product we:: we want to buy so (.) we know (.) we know what we're buying so". Daniel's latter account justified the situation by saying that providers give them information about what they buy, stressing that they know what they buy. At this level, I asked him: "You know, based on what they say?". He said: "((laughter)) yeah, but we cannot for everything", which means that they do not know. Daniel then explained more why they should trust these products: "in these companies, there are: a lot of steps also to check purity quality of the products so". He confirmed that the trust on which he built his position is entirely out of his control by mentioning what the companies do rather than what he does to ensure he receives exactly what he needs. One more time, I wanted to make sure that the lab does not do anything to ensure that the parameters of its experiments are under its control, so I said: "but it's a problem because if uh you're doing research and things are not under your control (.) you're not 100% sure that these things are correct."

Gaelle's was straightforward. She said that they trust providers because they have quality controls: "Yes (.) otherwise we will not ((laughter)) use them (;) and they have to::: take uh check so they have quality control in the industry so:::". She added: "but they have quality u::h quality test and quality u:::h they have good manufacturing procedures ((laughter))". She also said that they depend on providers because they cannot do everything by their own: "Yes (.) we do the::: without the: company we can't do a lot of things". When I asked Gaelle whether they can check if providers would alter the products, she said: "No we don't check u::h". She then said: "uhm (.) but since we cannot check (.) we will not (.) we are not able to check ((laughter))". I asked if providers are able to totally know their products and if they do would they tell everything to them; she said: "Yes but if they know what they put in (.) they will (.) it's u::h a nonsense to not tell uh (.) the people (.) who buy it so (.) there is no reason to tell you that it's the wrong uh".

Findings

The results suggest that researchers typically have confidence in the machines they utilize. However, there is a discrepancy in their comprehension of the machines' functioning and ability to measure the intended variables accurately. We here refer to all sorts of machines used as black boxes in fundamental research, ranging from centrifuges and microscopes to other tools such as western blotting. Some participants rely on the manufacturers' reputation, colleagues' recommendations, or the assumption that the machines are well designed without further questioning. There is a lack of awareness or concern about the potential for machines to produce inaccurate measurements or the need for critical examination of their functioning. The researchers take the machines' validity for granted and do not question whether they measure what they initially intended. This lack of critical evaluation can lead to potential skew or inaccuracies in research outcomes. Ethically, researchers have a responsibility to ensure the validity and reliability of the tools and equipment they use in their research, as they should be held accountable for the outcomes of their research. While it seems unrealistic for researchers

Table 1 Summary of findings.

What is the risk?	The risk of excessive trust in:
	1. Machines: Researchers need to ensure that machines are, in effect, measuring what they want. They assume they are functioning correctly, providing no troubleshooting or discrepancy emerges. 2. Consumables: Researchers need to ensure that the readymade consumables are, in effect, identical to how the providers describe them.
Why is this risk accepted?	As accounted for by participants (verbatim): 1. "Machines are expensive, so they are valid"; "People who made them are competent"; "We get advice before buying them"; "We know how they work." 2. "Providers are professionals and trustworthy"; "no reason to cheat." From Analysis: 1. Machines are trusted unless they go out of order or break (a practice taken for granted)—no distinction between machines' reliability and validity. 2. Providers are trusted because they are accounted for to be professional and precise and because they do their controls. Providers are considered trustworthy because their business and reputation are at stake.
When is this occurring?	All the time: for all types of experiments and consumables.
Where is this issue occurring?	Participants claim that their practices are also applied elsewhere, including in their previous labs in other countries (in the USA, France, Belgium, Netherlands, and Spain).
How does this occur?	Prior to our interviews: The issue has gone unnoticed by all participants, who claim they never discussed such "philosophical" issues. Through this research: During the individual interviews, all participants - except for one postdoc did not consider this trust risky. In the collective interview, all participants accounted for the risk of skewing the research results ("blinding", "phenotype change", "I hope we can trust otherwise (.) this would change a lot").
Implications of our findings on cancer research?	1. Cancer researchers can expect any skews if they build knowledge on machines as black boxes. 2. If researchers purchase "everything" readymade from providers and do not ensure that the composition is accurate, they can expect any skews. "Everything and 100%" are expressions used by our participants.

to check or monitor every aspect of their experiments by themselves, they should be aware of the degree to which they do their research. Ongoing situational awareness is crucial in maintaining accountability and understanding the scope of their contributions. By any means, the paper does not blame the researchers. It simply exposes a status quo that the broader scientific community should know. It is worth noting that researchers need more comprehensive awareness and ownership regarding their research in today's science structure. However, future substantial reforms or profound changes in scientific research practices could mitigate or entirely prevent such a shortcoming.

The findings also highlight a contradiction related to the use of consumables (e.g., medium, trypsin, cell lines, buffers, disks, flasks, filters, and more). On the one hand, the researchers expressed their need to trust providers. On the other hand, they described the potential risks associated with deviations from specified standards and the challenges in detecting and addressing mistakes or inconsistencies in these materials. The findings indicate that before our research, the scientists lacked awareness or concern about the potential risks of total reliance on external providers. Critical examination is necessary to maintain scientific research's integrity and boost knowledge-building progress. The data analysis also implies complacency or shifting of responsibility onto external providers, assuming that they have no interest in altering the composition of the consumables. Given this fact, researchers are responsible for critically evaluating the materials they use and actively participating in ensuring the validity and reliability of their research. Researchers should have access to accurate and comprehensive information about the materials they use to make informed decisions and mitigate potential biases or inaccuracies in their research.

Machines and consumables are part of the worldwide standards, and if mistakes or problems exist, they are likely to be widespread, making it difficult for individual labs to identify them. In our case, the researchers express trust in machines and external providers, but this trust emanates from subjective value judgments rather than factual accounts. There appears to be a need for more awareness or consideration regarding the possibility of providers intentionally or unintentionally altering the composition of their products. While some participants dismiss this idea, they acknowledge the unknown consequences of such actions (i.e., blinding). Table 1 below summarizes our findings:

Concluding remarks

Upon conducting ethnographic research within the cancer research lab, this study unveils some seen but unnoticed ethical pitfalls that come into play while building scientific knowledge. The findings highlight critical ethical implications in lab research practices. Specifically, they should show a more comprehensive understanding of the machine's functionality, which is crucial for research integrity. Furthermore, the reliance on external providers without verifying the contents of the consumables raises concerns about the validity of research outcomes. In line with previous ethnographies conducted by Mnasri, Papakonstantinidis (2020) and by Mnasri and Jovic (2023) within cancer research labs, this situation poses a risk to research integrity, compromises the responsible conduct of research and questions the responsible use of resources and technologies.

This ethnographic study emphasizes the need for a critical evaluation and a deeper understanding of machine's validity in research. It also underscores the potential risks and challenges of heavily relying on external providers for consumable materials. The researchers' trust in machines and consumables emanates from subjective value judgments and assumptions rather than scientific evidence or control over research elements. These conclusions accentuate the importance of critical awareness, evaluation, and consideration of potential risks and uncertainties to ensure the reliability and integrity of scientific research outcomes. It is also worth noting that the current study has at least one limitation. The current study's small sample size may limit the results' generalizability to a broader population of cancer research labs. In a single cancer research lab, the number of researchers is relatively small, leading to a limited pool of potential participants for the study.

Data availability

The datasets generated and/or analyzed during the current study are available here: https://doi.org/10.6084/m9.figshare.25325899.v1.

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References

All European Academies (ALLEA) (2017) The European code of conduct for research integrity. ALLEA, Berlin. https://allea.org/code-of-conduct

Atkinson JM, Heritage J (1984) Structures of social action: studies in conversation analysis. Cambridge University Press, Cambridge

Bærøe K, Kerasidou A, Dunn M, Teig IL (2022) Pursuing Impact in Research: Towards an Ethical Approach. BMC Med Ethics 23(1):37. 101186/s12910-022-00754-3

Beauchamp TL, Childress JF (2019) Principles of biomedical ethics. Oxford University Press, Oxford

Besley JC, Dudo A, Yuan S, Lawrence F (2018) Understanding scientists' willingness to engage. Sci Commun 40(5):559–590. https://doi.org/10.1177/1075547018786561

Buedo P, Odziemczyk I, Perek-Bialas J, Waligora M (2023) How to embed ethics into laboratory research. Account Res 40(2):1–2. https://doi.org/10.1080/08989621.2023.2165916

Burget M, Bardone E, Pedaste M (2017) Definitions and conceptual dimensions of responsible research and innovation: a literature review. Sci Eng Ethics 23(1):1–19. https://doi.org/10.1007/s11948-016-9782-1

Callon, M (1986) Some elements of a sociology of translation: domestication of the Scallops and the Fishermen of St Brieuc Bay. In John Law(ed) Power, action, and belief: a new sociology of knowledge, Routledge and Kegan Paul, London, p 196–223

Hardin, R (2002) Trust and trustworthiness. Russell Sage Foundation, New York

Laas K, Taylor S, Miller C, Brey E, Hildt E (2022) Views on ethical issues in research labs: a university-wide survey. Account Res 29(3):178–201. https://doi.org/10.1080/08989621.2021.1910503

Latour B (1987) Science in action, how to follow scientists and engineers through society. Harvard University Press, Cambridge

Latour B (2005) Reassembling the social: an introduction to actor-network-theory. Oxford University Press, Oxford

Latour B, Woolgar S (1979) Laboratory life: the construction of scientific facts. Princeton University Press, Princeton

Mejlgaard N, Bouter LM, Gaskell G, Kavouras P, Allum N, Bendtsen A-K, Charitidis CA, Claesen N, Dierickx K, Domaradzka A et al. (2020) Research integrity: nine ways to move from talk to walk. Nature 586(7829):358–360

Mnasri S, Papakonstantinidis S (2020) Detrivialization as a strategy to challenge organizational groupthink. Electron J Knowl Manag 18(3). https://doi.org/10.34190/EJKM.18.03.003

Mnasri, S, Jovic, M (2023) On the need to explicitize the unstated argument in cancer- research: an ethnography on scientific argumentation. J Hum Soc Sci Commun 18(3). https://doi.org/10.1057/s41599-023-01823-7

Mnasri S, Papakonstantinidis S (2023) The teaching-learning dynamic from behaviourism to social constructionism: a communication-centred narrative. Int J Learn Change 15(3). https://doi.org/10.1504/IJLC.2023.130629

Nuffield Council on Bioethics (2012) Emerging Biotechnologies: technology, choice and the public good. Nuffield Council on Bioethics, London. https://www.nuffieldbioethics.org/publications/emerging-biotechnologies

O'Mathúna D (2007) Bioethics and biotechnology. Cytotechnology 53(1–3):113–119. https://doi.org/10.1007/s10616-007-9053-8

Resnik, DB 2015 What is Ethics in Research and why is it Important? National Institutes of Health. https://www.niehs.nih.gov/research/resources/bioethics/whatis

Resnik D, Lee E, Jirles B, Smith E, Barker K (2023) For the 'Good of the Lab': insights from three focus groups concerning the ethics of managing a laboratory or research group. Account Res 30(4):1–20. https://doi.org/10.1080/08989621.2021.1983799

Schudson ZC, Gelman SA (2023) Social constructionist and essentialist beliefs about gender and race. Group Process Intergroup Relat 26(2):406–430. https://doi.org/10.1177/13684302211070792

Second World Conferences on Research Integrity (2010) Singapore Statement on Research Integrity. Singapore. https://www.wcrif.org/guidance/singapore-statement

Sixth World Conferences on Research Integrity (2019) Hong Kong Principles. Hong Kong. https://www.wcrif.org/guidance/hong-kong-principles

Sugarman J, Bredenoord A (2020) Real-time ethics engagement in biomedical research ethics from bench to bedside. EMBO Rep 21(2):e49919. https://doi.org/10.15252/embr.201949919

Third World Conferences on Research Integrity (2013) Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations. Montreal. https://www.wcrif.org/guidance/montreal-statement

Yarborough M (2021) Using the concept of 'deserved trust' to strengthen the value and integrity of biomedical research. Account Res 28(7):456–469. https://doi.org/10.1080/08989621.2020.1855427

Yarborough M (2014) Taking steps to increase the trustworthiness of scientific research. FASEB J 28(9):3841–3846. https://doi.org/10.1096/fj.13-246603

Zwart, H, Ter Meulen R (2019) Addressing research integrity challenges: from penalising individual perpetrators to fostering research ecosystem quality care. Life Sci Soc Policy 15(1). https://doi.org/10.1186/s40504-019-0093-6

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Author contributions

SM and FJ contributed to the following areas: conceptualization, SM and FJ; methodology, SM and FJ; resources, SM and FJ; writing—original draft preparation, SM; writing—review and editing, SM and FJ; project administration SM. Correspondence to SM. SM and FJ have read and agreed to the submitted version of the manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

Approval was obtained from the ethics committee of the Catholic University of Louvain, Belgium (reference: CE-ILC/2023/01). The procedures used in this study are unrelated to the Declaration of Helsinki because we do not observe or interview patients. We only observed and interviewed scientists who work on cell lines in their lab (fundamental and not clinical research).

Informed consent

Informed consent to participate in the study was obtained from participants. Additionally, informed consent to publish data was also obtained from participants. Our participants are scientists working on cells in their lab (no patients or clinical work involved).

Additional information

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