

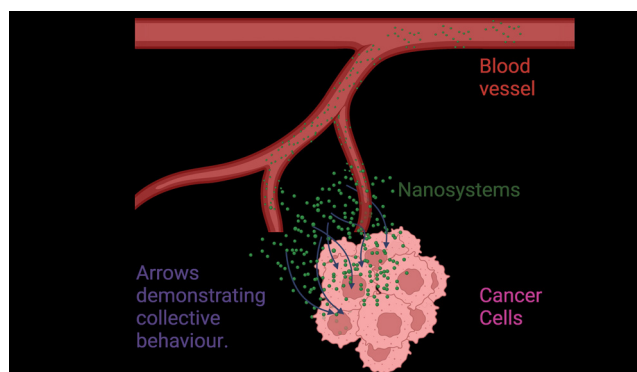
Co-creating ethical horizons: Public attitudes and regulatory considerations for future cancer nanomedicines in clinical trials

Matimba Swana, Jonthan Ives and Sabine Hauert (University of Bristol)

About the research

The advancement of future cancer nanomedicines, like collective nanosystems, offers a chance to promote responsible governance by anticipating technological developments and addressing ethical issues. Collective nanosystems are large numbers of tiny nano-sized carriers that work together to find and remove cancer cells, drawing inspiration from teams of cooperative robots. Computer models and artificial intelligence can be used to enhance collective nanosystem design, aiming to accelerate targeted treatments and streamline drug development by reducing experimental time.

This policy briefing summarises findings from an ongoing PhD project focused on the ethical implementation of collective nanosystems in cancer clinical trials. It seeks to identify regulatory gaps and support ethics committees, regulators, and policymakers in adapting and evolving their ethical frameworks for collective nanosystems in future cancer clinical trials. The PhD used participatory approaches, including interviews, focus groups, and public engagement activities. This involved regulators, policymakers, nanomedicine researchers, healthcare professionals, cancer patients, carers, private and third sector organisations, and interested members of the public. Participatory approaches highlighted the importance of consultation and co-design for the acceptance of future collective nanosystems in cancer trials.



Collective nanosystems interact with each other and react to their surroundings through cooperative behaviour to target a cancer cell.

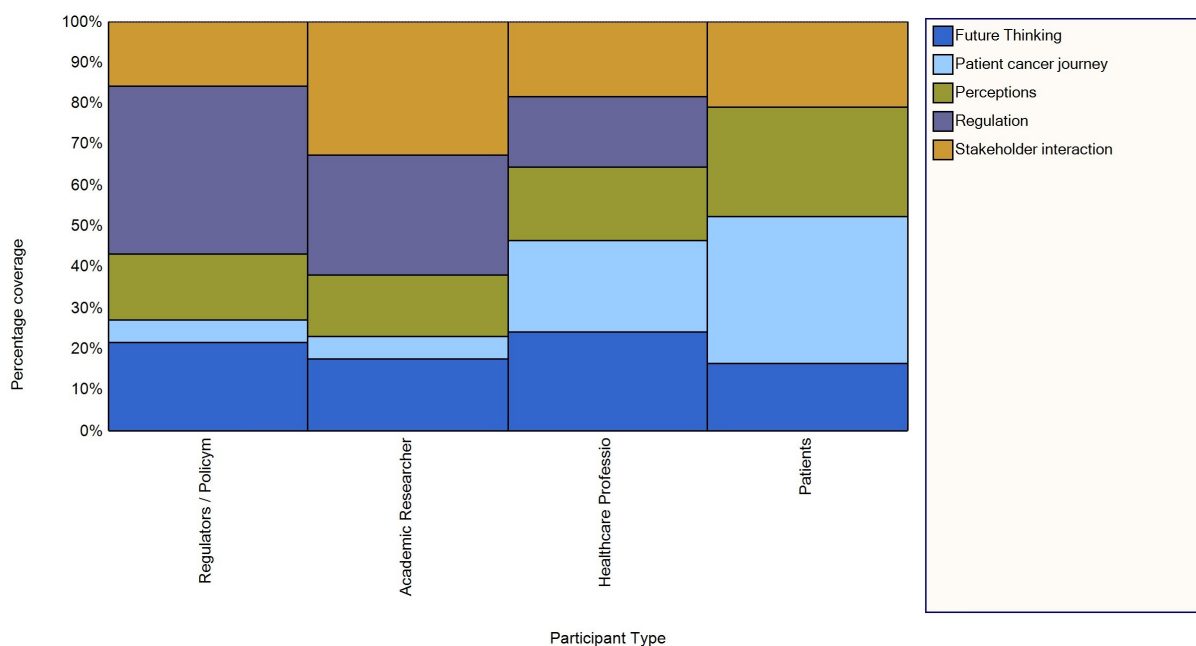
Policy implications

The following recommendations are proposed for future collective nanosystems in cancer clinical trials:

- Encourage co-creation in the development of collective nanosystems in clinical trials to address the needs and concerns of everyone involved; and foster collaboration among researchers, patients, healthcare professionals, and regulators to ensure comprehensive engagement.
- Highlight the necessity of integrating a mechanism to safely neutralise and remove collective nanosystems from the body.
- Develop adaptable consent processes that clearly explain the technical aspects and adaptability of collective nanosystems, and any uncertainty, to enhance patient understanding and participation.
- Provide accurate information to address public perceptions and counter misinformation, ensuring clear communication throughout research phases to build and maintain trust.
- Provide guidelines on how to conduct clinical trials using computer models to prevent biased outcomes, encourage interdisciplinary research, and promote responsible data practices.
- Incorporate ethics training aimed at future researchers working on collective nanosystems. Highlight ethical design principles while promoting safety, transparency, inclusivity, environmental sustainability, and consideration for the welfare of impacted communities.

Key findings

- Cancer patients show openness to collective nanosystems, carefully weighing risks and benefits related to safety, family responsibilities, and quality of life.
- Building trust in individuals, processes, and systems are important for successful collective nanosystem cancer trials. Transparency can help improve trust.
- People desire consent processes that are clear, accessible, culturally respectful, and understandable.
- Patients and healthcare providers focus on the cancer journey, often overlooked by regulators and researchers. Patients may disregard regulatory processes, while healthcare professionals and researchers worry that excessive regulation could stifle innovation. Regulators recognise the regulatory challenges of collective nanosystems, leading to conflicting priorities.
- Artificial Intelligence and Robotics in popular culture and science fiction are often referenced to explain societal attitudes to collective nanosystems, especially in relation to public perception, inequality, trust, and misinformation.
- While these findings apply to people who engaged in the participatory activities, it is important to recognise that not all people will have the same attitudes and beliefs towards collective nanosystems in cancer clinical trials.



Graph displays participant groups in interviews and the frequency of discussed themes, revealing a disconnect between users and creators or regulators. This is based on interview data from the [SWARM](#) study.

Further information

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Contact the researchers

Ms. Matimba Swana, PhD student, University of Bristol, matimba.swana@bristol.ac.uk

Prof. Jonathan Ives, Professor of Empirical Bioethics, University of Bristol, j.ives@bristol.ac.uk

Prof. Sabine Hauert, Professor of Swarm Engineering, University of Bristol, sabine.hauert@bristol.ac.uk