

Statement – 1st International Conference Ethics of Engineering Life (ICEEL)

New biotechnologies are becoming more viable and have the potential to affect the lives of millions of people around the world. Issues emerging from their development may be considered under two main perspectives: the need i) for researchers and, more broadly, all the stakeholders involved in the translation from the lab to the real world to be aware of the ethical, legal, and political implications; and ii) to foster dialogue with the public on these implications. In this regard, it is crucial to inform citizens properly about these new technologies and their ethical implications. Equally important, all stakeholders must take into consideration citizens' worries, doubts, and real needs to foster clarity and trust between them and the scientific community with respect to these delicate scientific developments.

IC: International Conference

The first conference on Ethics of Engineering Life took place at the Vatican (September 26-27, 2022) as a signal of the importance of an ethical reflection on the engineering of molecular and cellular systems (MCSE) for clinical applications and the good they can achieve in patient's outcomes. Participants of the conference were stakeholders from various scientific, ethical, political and religious backgrounds, and reflected a broad international diversity. The choice of this site must be intended as symbolic, meaning a space open to dialogue, in which it is possible to discuss sensitive topics from different points of view in terms both of various scientific areas of research and of cultural and religious traditions. With these assumptions, the conference was intended as a call to open the discussion on the ethical issues raised by developing new biotechnologies by providing a space for a range of views to be expressed. The goal of the conference was to integrate different perspectives and contributions to discuss their implications together.

E: Novel Engineering

Novel biotechnologies based on the engineering of MCSE that are in development or have been recently implemented were discussed. In these new engineering principles, molecules and cells become "factories", thus able to provide products and functions to living systems. This opens new ways for providing innovative diagnostic tools, therapies to restore damaged functions of living systems, and possibilities to enhance their functions. Among others, examples of MCSE that were discussed are gene-based therapies for vision restoration and other serious and genetic complex disorders; organoid-based engineering, where an organ tissue is grown outside of the human body using stem cells; gastruloids, aggregates of stem cells, previously developed with mouse cells, with the first human model system developed in 2020; and digital twin technology, simulating a patient's body in digital form to find effective drug therapies without physical intervention. As mentioned above, these new biotechnologies that have an impact on human health and on the Human Condition per se also imply new ethical responsibilities. In their translation from the lab to the real world, and in their actual application, especially in clinical practice, ethical issues must be considered.

E: The Role of Ethics

In such a sensitive context, ethical questions would benefit from a transdisciplinary perspective to frame the questions and possibly find conceivable solutions in the logic of the greatest possible consensus. Thus, different fields of expertise must interact to foster a productive dialogue based on what are considered to be relevant ethical principles and human rights. Given the sensitivity of genome interventions and the uncertainty of the effects (particularly with respect to germ cells), a central role must be given to the precautionary principle (COMEST, UNESCO 2005). Other principles

worth citing are human dignity and vulnerability, for which human persons have to be respected in their specific difference; autonomy and individual responsibility, preserving the right to choose but also the need for the awareness of the meaning of choice for others; equality and non-discrimination, with the aim of being inclusive of all the social layers (social justice), cultural backgrounds, and religious traditions, ensuring a fair distribution of the burdens and benefits of new discoveries in relation to the real needs of populations and common good in a global perspective; protection of the environment, that reveals itself to be urgent, also concerning the respect of other (non-human) living organisms; and the responsibility towards future generations¹. Reflection is needed to better specify the ethical implications of translational processes to support the transition from the laboratory to the real world, that deserves prudence. In other words, technologies are double-edged, in the sense that their use can have different, sometimes opposite, effects. Ethics is therefore to be seen as a source of inspiration for the whole process from the design, research, production, and application of MCSE technologies to their dismantling: this is what is meant when speaking about “ethics by design”, a term coming from the AI and also employable in this context. .

L: Life Lessons

The conference gave the opportunity to create a dialogue between the different stakeholders involved in the application of Engineering Life to clinical practice. Many questions and topics that need to be further explored arose from the ethical perspective. Among others: what are the differences between the implementation of these technologies in terms of therapy and/or enhancement? How to take correctly into account the difference between germline cells and somatic cells? What is the role of ethics in the process of translation of knowledge? How is it possible to make the benefits accessible to everyone? How can we preserve a pluralistic approach? What has to be the role of the bioethics committee in developing guidelines and/or policies on this topic? In a world in which Engineering Life is rapidly improving, and new challenges arise in its application, a common effort to disentangle these moral issues would imply universal benefits in terms of ethical admissibility and allow to find the right path forward. Promoting a fruitful dialogue among different disciplines and relevant stakeholders (scientific communities, sponsors, universities, institutions, policymakers, biotech companies, healthcare providers, communicators, patients, religious traditions, and the general public) with an overall specific focus on young generations is among the primary goals for the immediate future. The hope is indeed to continue this enriching interaction, essential to improve the relations between science, society, and cultures.

The Organizing Committee *

Ralf Stutzki, *NCCR MSE, University of Basel, CH*

Daniel Müller, *NCCR MSE, ETH Zurich, CH*

Renzo Pegoraro, *Pontifical Academy for Life, Vatican City*

Carlo Casalone, *Pontifical Academy for Life, Vatican City*

Bruno Dallapiccola, *Bambino Gesù Children's Hospital, Rome, IT*

Alberto Tozzi, *Bambino Gesù Children's Hospital, Rome, IT*

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¹ To have a complete overview of the list of the principles that, according to the UNESCO, must be respected, see the document by UNESCO 2005; and UNESCO 2021 on the principle of protecting future generations.

Literature

1. Choi, Bernard CK, and Anita WP Pak. 2006. Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. *Clin Invest Med*. 29(6): 351-364.
2. COMEST, UNESCO. 2005. *The Precautionary Principle*. <https://unesdoc.unesco.org/ark:/48223/pf0000139578>
3. Francesco. 2018. Costituzione apostolica "Veritatis Gaudium". *AAS110*(1): 1-41.
4. Kagarise MJ, and GF Sheldon. 2000. Translational Ethics. A perspective for the New Millennium. *Archives of Surgery* 135(1): 39-45.
5. Moris, Naomi, Kerim Anlas, Susanne C van den Brink et al. 2020. An in vitro model of early anteroposterior organization during human development. *Nature* 582(7812): 410-415.
6. Sinibaldi, Edoardo, Chris Gastmans, Miguel Yáñez et al. 2020. Contributions from the Catholic Church to ethical reflections in the digital era. *Nature Machine Intelligence* 2(5): 242-244.
7. UNESCO. 2005. *Universal Declaration on Bioethics and Human Rights*. UNESCO. http://portal.unesco.org/en/ev.php-URL_ID=31058&URL_DO=DO_TOPIC&URL_SECTION=201.html
8. UNESCO. 2021. *Declaration on the Responsibilities of the Present Generations Towards Future Generations*. <https://en.unesco.org/about-us/legal-affairs/declaration-responsibilities-present-generations-towards-future-generations>