Review Article

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Biorg-T: A Patient-Centred Digital Prototype to Navigate the Transplantation of Bioartificial Organs

Elena Salvaterra

Europa Uomo Schweiz, Eichweg 9, 4614 Hägendorf, Switzerland.

***Correspondence:**

Elena Salvaterra, PhD, Europa Uomo Schweiz, Eichweg 9, 4614 Hägendorf, Switzerland.

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ABSTRACT

This article reports a conceptual foundation for the Biorg-T mobile application, a prototype of digital health ecosystem designed to empower patients throughout their bio-printed organ transplantation. Biorg-T describes the bio-printing process from the patient cell extraction to the transplantation and the related follow-up. It clarifies the ethical framework of elastic consent and outlines each clinical stage, providing future users of the platform with the transparency and agency required for active participation in their own care. Biorg-T fosters an alliance between clinical teams and patients, empowering them to become active and responsible decision-makers in ongoing clinical trials.

Keywords

Bioprinted organ transplantation, Digital health ecosystem, Patient-centered care, Mobile health application (mHealth), Elastic consent, Patient empowerment, Clinical trial participation.

Introduction

The emergence of bio-printed organ technology represents a paradigm shift in regenerative medicine [1]. Unlike traditional transplantation, which relies on scarce donor organs and carries risks of immune rejection, bio-printing utilizes the patient's own biological material or cells deriving from donors to construct functional organs. Considering that this technology is currently in a developmental phase and it is not yet based on dedicated information and consent models [3], the Biorg-T application is designed to bridge the information gap, ensuring that patients manage their treatment pathway with full knowledge, agency, and clinical support.

What is Bio-Printed Organ Technology

The Core Principle

Bio-printing applies additive manufacturing to living tissue by depositing layers of bio-inks composed of living cells and biomaterials [4]. By utilizing cells deriving from patients or donors, engineers and clinical teams can construct 3D personalized anatomical structures that minimize or eliminate rejection risks.

The Physics of Certainty

A foundational pillar of the Biorg-T prototype is the integration of physic parameters. Biorg-T architecture uses computational fluid dynamics (CFD) and mass transfer modeling to verify structural integrity and nutrient diffusion, providing a quantitative assurance layer that complements biological observation [5,6].

The Clinical Journey: Managing via Biorg-T

The Biorg-T app protorype acts as a digital companion, providing patients with real-time tracking for the following stages:

Stage 1: Assessment and Cell Collection

The journey begins with a health review and a 3D scan of patient body to create a precise map of the organ. A small sample of patient or donor healthy cells is collected through a minimally invasive procedure.

Stage 2: Shaping the Cells

Collected cells are mixed with a special gel that acts as a scaffold. The printer builds the organ layer by layer, following the 3D digital model. The gel provides the structure, holding the cells in place while they begin to bond.

Stage 3: The Growth Phase

The printed organ is moved to a "bioreactor". This is a special, safe

chamber that acts just like the patient body. It provides the right warmth, oxygen, and nutrients to help the organ grow strong.

Stage 4: Storage and Readiness

If the organ is ready before the surgery, it is stored at a temperature-controlled environment. The "readiness" signal happens only when the organ meets all safety and physics-based rules.

Stage 5: The Transplant Surgery

When it is time, the surgical team transplants the organ by explaining the patient the surgery processes.

Stage 6: Recovery and Long-Term Care

The patient journey continues after the hospital leave. The clinical team uses regular check-ins to monitor how the new organ is working inside the body and ensure the patient feel supported during the recovery.

The Ethical Framework: Elastic Consent

Traditional informed consent is often a one-shot event. In contrast, the Biorg-T app prototype utilizes elastic consent, a dynamic, longitudinal model defined by transparency, reciprocity, and the right to revisability [7]. This framework acknowledges the boundaries of clinical knowledge, providing patients with a “map of the unknown” regarding emerging technologies [3].

Elastic Consent means hat the patient is “the captain” of her/is care during the bioartificial organ transplantation journey. The patient has the right to know exactly the bioprinting process, the transplantation procedures and the risks and benefits related to the whole process.

As the patient organ grows or as the clinical team gets new data from the lab, information are shared with the patient in a plain language. If the treatment changes, the consent is updated to reflect that new knowledge. If at any point the patient feels unsure, or simply needs more time to think, he/she can pause the process. Patients can change their mind, ask for a different approach, or decide to stop altogether.

Community Safety, Public Health, Regulatory Compliance

All procedures monitored via Biorg-T adhere to rigorous biosafety protocols, including pathogen screening and longitudinal reporting to ensure public health safety during the integration of bio-printed materials [8]. It also adheres to the regulatory criteria currently established internationally.

Guidance for the Clinical Consultation

Biorg-T empowers patients to arrive at consultations with data-driven questions such as: what does the most recent fluid-dynamic modeling reveal about my organ’s perfusion capacity?
How do the latest bio-marker trends impact my current recovery timeline?
How can I adjust my preferences within the Biorg-T consent module based on these new findings?

Conclusion

Bio-printed organ transplantation is a synthesis of biology, physics, and digital-enabled ethics. By utilizing the Biorg-T app protoype, patients move from being passive recipients to informed decision-makers of their own clinical journey. Biorg-T is designed to be utilized during ongoing clinical trials to test its effectiveness and refine its features and criteria based on the needs of both patients and physicians. The app's objective is to foster an effective synergy among physicians (mainly surgeons), nurses, and patients (along with their families, if desired) to transform the bioartificial organ transplant into a dual-steered journey—guided by both the clinician and the patient—while always leaving the final choice to the latter. In this light, the digital prototype operates as a flexible decision-making tool. Biorg-T proposes a digital paradigm to address the ethical and legal issues raised by bioartificial organ transplantation.

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