

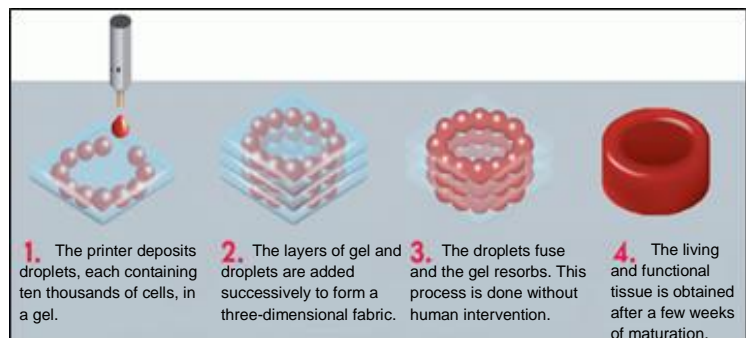
## Bioprinting, an upcoming revolution?

Toulouse, June 12th, 2019 – In April, researchers at Tel Aviv University succeeded in recreating a vascularized heart through 3D printing. Even if the organ was the size of a cherry, the progress is immense, and research is getting closer to the ultimate goal of reconstructing organs. The field of bioprinting is booming as many applications are being developed. Alcimed, an innovation and new business consulting firm, analyzes the potential of this innovative technology.

### Bioprinting: definition

Bioprinting is a biomedical application of technologies. It uses the principles of 3D printing to artificially produce living biological tissues.

Computer-assisted **tissue** formation is based on the assembly, layer by layer, of **living cells** and other biological products, all of which constitute a bio-ink. Actually, this technology could be labelled 4D printing since the **dimension of time** also has to be considered: through self-organization, the printed cells will migrate in order to create a functional fabric.



<https://impression3dmedecine.wordpress.com/we-2/>

### Concrete and very promising applications in the near future....

If bioprinting is a booming field today, it is because of its multiple and promising potential applications, both in treatment and in research.

- The first application of bioprinting is therapeutic: the **creation of organs** or **parts of organs** to be transplanted into patients. Two major issues are addressed: **donor-receiver compatibility**, which would no longer be an obstacle, and **waiting time** for a transplant. Additionally, assuming that the printed organs are not stable over time, they could still **stabilize patients** before finding a compatible donor.
- The second application of interest concerns clinical research in humans, where the creation of an entire organ can be used as an **excellent predictive model**. The exploration of pharmacological parameters could be carried out in bio-printed organs and no longer in humans, hence simplifying the clinical phases of drug experimentation. By reconstructing pathological tissues from patients' malignant cells, it is possible to explore their response to **different therapeutic protocols** on an individual basis. The end goal is to provide personalized medicine, allowing access to **optimal treatments and dosages**, thus **reducing the number of adverse events** and **therapeutic failures**.
- As with human experimentation, bioprinting is also of great interest as a replacement for **animal testing**. This is particularly the case in **cosmetics**, where it offers an extremely interesting alternative to the legislation (dated 2009, entered in effect in 2013) that has banned animal testing for all cosmetic products placed on the European market. By recreating human skin tissue, cosmetic laboratories can perform as many tests as necessary without using animals. L'Oréal's has already adopted this idea. In 2015, the French cosmetics company partnered with Organovo, an American start-up, which is a pioneer in bioprinting.
- Finally, recreating organs is also an alternative for **surgery training**. Whether orthopaedic or visceral surgery, if medical interns had the opportunity to practice on bioprinted organs, the transition to the operating room could only be improved.

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... which remain, however, hampered by multiple constraints

While bioprinting seems to be the key to several bottlenecks in healthcare, many challenges remain, starting with the **cost**. Functional biological printers remain very expensive and therefore the potential treatments will also be expensive. As it is often the case, this type of technological progress is not within everyone's reach, which increases **inequalities in access to care**.

In addition, significant **technical challenges** remain. To design a functional organ, it is still necessary to solve the challenges **vascularization, innervation and gravity**. The vascular and nervous interconnection of the built organs is not yet controlled, nor is the loss of structure over time due to gravity.

Finally, bioprinting raises **ethical questions** at several levels:

- **Technically** speaking, the use of **embryonic stem cells** remains highly controversial, while the main alternative, induced pluripotent stem cells (iPS), is still technically immature.
- At the level of the concept itself, the future fear of **transhumanism** surrounds bioprinting. The misuse of bioprinted organs for the purpose of improving humans' capacity and performance, or even for complete human cloning, could pose serious bioethical problems. This "artificial evolution" of mankind, if it comes into existence, will have to be strictly controlled to avoid its potential drawbacks and risks.

In this sense, a philosophical question arises: "If we can reproduce an organ by assembling cells, can we one day create a brain de novo, and with it consciousness?" asks Marie Rolin, Alcimed's Project Manager.

This question shows the enormous potential of this new technology.

## About Alcimed - [www.alcimed.com](http://www.alcimed.com)

Founded in 1993, Alcimed is an innovation and new business consulting firm specialized in life sciences (healthcare, biotech, agri-food), chemicals, materials, energy and mobility; as well as in aeronautics, space & defense, and public policies. Today Alcimed works with major industrial groups, SMEs, private equity players, start-ups, and institutional players. ALCIMED relies on a team of 180 highly-skilled individuals to help its clients in the exploration and development of their uncharted territories: new technologies, new offers, new geographies, possible futures, and new ways to innovate. Alcimed is headquartered in Paris and has offices in Lyon and Toulouse in France, as well as in Germany, Belgium, Switzerland, the United-States and Singapore.

Alcimed is a member of CroissancePlus and the ACI (Association des Conseils en Innovation – Association of Consultants in Innovation).

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