

Marketplace for 3D Bioprinters

Ankan Ghosh¹, Samabrita Biswas², Abhirup Ghosh³, Swananya Nayak⁴, Dr. Danie Kingsley J*

¹⁻⁴Vellore Institute of Technology, Vellore, Tamil Nadu, India 632014

*Assistant Professor, School of Bioscience and Technology, VIT Vellore, Tamil Nadu, India

Abstract -Organ transplantation through donors has been a major concern, there has been a shortage of organ donations that has led to the loss of many lives. Through organ donations. Many times patients undergo immunological rejections. Moreover many religious beliefs limit people to undergo immunological rejections. Moreover many religious beliefs limit people to undergo organ transplantation. Many of these hurdles can be resolved with the utilization of 3D-Bioprinters. It uses 3D technology to create artificial organs made from a patient's own cells. Organ transplantation can have a high success rate with this instrument. However there are no such platforms to facilitate the accessibility of this instrument. Therefore, our project aims to create a marketplace through online website service for connecting the manufacturers and purchasers (majorly hospitals) of 3D Bioprinters. Through our website, a purchaser and a seller will have to register for validating authenticity. Thereafter, a purchaser can browse and buy the appropriate instrument of their choice based on the registered products of the sellers. Online payment methods and logistics shall also be catered. We seek to enhance the availability of this instrument to all the possible centres where transplantation takes place. We estimate that with this instrument, the heavy cost of organ transplantation can also be lessened and a lot of patients can be saved.

Keywords: 3D Bioprinter, Healthcare, Discriminate the risks of traditional organ transplantation, online service, website, bioink

1. Introduction:

All the organs in the human body are very much necessary to lead normal life. All the metabolic activities needed to survive is regulated by specific organs which cannot be done by any other organ in the body. So, it is obvious that each organ in our body has its specific and unique sets of functions that can be done by only that particular organ [1]. From that base, we can assume that if any organ of the human body leads to failure, how much disaster can happen. Without a particular organ, it is not possible for a person to live [2]. If an organ fails, the traditional method to cure the problem is to find a donor, most preferably a close relative of the patient and take out the particular organ from the donor and introduce it into the patient discarding the old, failed organ [3]. Anyway, those organs which are present more than one in number in the human body (eg: kidney) this process is quite possible. But for those organs which are present only one in number inside the human body (eg: heart, liver etc) this process becomes quite complicated. Then the only way comes is to find a person who just died or is going to die surely and he or his family agrees to donate his organs [4]. This comes relatively impossible most of the time. On the other hand, the cost of transplantation by this way is very much high. According to a TOI report in 2019, private hospitals charge 10-30 lakhs for heart transplantation, 5-20 lakhs for kidney transplantation and 15-35 lakhs for liver transplantation. Most of the time this cost is unbearable by common people, especially those who have lower incomes [5]. After these, the success rate problem comes. The success rate is also not satisfactory by this process. Luckily if the transplantation operation succeeds, the patient has to take immunosuppressive drugs throughout the life that hampers the immunity of the person and prone to a number of diseases [6]. Moreover, religious belief sometimes limits people to accept an organ from another, unknown person. Here is the success of our product, 3D bioprinter. 3D bioprinter is a machine which can produce organs using bioink which consists of biopolymer gel and cells taken from the patient [7]. Thus the organ produced is just a copy of the patient's own organ and all the risk factors and limitations of traditional organ transplantation are abolished [8]. It is easily accepted by the immune system and the patient has not to take any immunosuppressive drug. Our company, YORGAN is bringing an online platform for distributing 3D bioprinters to hospitals, healthcare centres or research centres where human organs are needed. Through our website, customers can login and order the particular bioprinter they want with their office address and we will be delivering the product there. This is our overall business planning.

2. Materials and Methods:

In our website service, a wide range of 3D bioprinters will be provided based on its categories. For storage and maintaining of data, My SQL database shall be used. Our website will also be built using PHP which is a server scripting language.

2.1. 3D Bioprinters

3D Bioprinters use bioink to create structures in a layer by layer manner. In this technology, a digital model is transformed to a physical 3D object using living cell suspension [9]. To maximize cell viability, sterile printing conditions are maintained for maximizing printing resolution with accuracy [10]. The main types of 3D bioprinters are :

- Inkjet Printers - It allows precise positioning of cells. It uses droplets ejected via thermal or piezoelectric processes.
- Extrusion Printers - It uses multiple print heads and prints multiple materials in a single construct.
- Laser assisted Printers - It is a nozzle free printing process that allows non-contact and high-resolution patterning.

With the advent of research and discoveries, many new technologies are used in 3D bioprinting such as syringe based extrusion or using multiple technologies together like photocuring, electromagnetic and extrusion[11]. Thus through our website all the bioprinters can be categorized for the convenience of the purchasers.

2.2. Data Storage and Security:

With the constant innovation in the healthcare sector and new technological adaptations, it becomes highly important for the proper storage and security of data. Cyber attacks over the internet are increasing at an alarming rate and it becomes indispensable to detect the security threats for large organizations like hospitals. Maintaining of the data is employed using data analytics and the confidential data is protected to prevent any form of illegal access. PHP is a hypertext preprocessor and is a server side programming language. One of the features of PHP is that it can interact with various databases including My SQL. My SQL is a structured query language which is a management system of relational databases. This application can be used for data warehousing, e-commerce and logging applications. Since our website service involves the storage of vital data from organisations like hospitals, it becomes crucial to have robust information security systems at all times.

3. Objectives and motivations:

The main purpose of this technology is with using this 3d printing technology to combine cells, growth factors, biomaterials to fabricate artificial parts of the body for those who lost their organs or are not able to do organ transplantation^{1 2}. The symbol of our logo is a leaf with many branches and the middle stem which is represent the human body and since this the new technology so the branches here that represent the easy accessibility of our service across various places and even outside India .There are several reason to implement this technology in the market; According to the report private hospital charge 10 lakh to 30 lakh for heart transplantation, 5 lakh to 20 lakh for kidney transplantation and 15 lakh to 35 lakh for liver transplantation which is huge amount for middle class people^{1 3}. The success rate of organ transplantation is not always successful for all; The shortage of organs is a major problem worldwide, but with this technology middle class people can afford it easily, no donor needed for this^{1 4}. It brings a new revolution in the health sector. So now the main problem is there is no existing platform to facilitate the transaction process of the instrument which can reduce this kind of problem. So to deal with those problems we made this company. For those places where we don't have any branch of our company, there consumers can also order this bioprinter from our website. Our main aim is to preserve life and promote connectivity to provide accessibility for catering to the needs of mankind with our services.

4. Business Model Canvas

4.1 Customer Segments:

Healthcare sectors, hospitals, nursing homes who have the facility and infrastructure for performing organ transplantation are the major part of the customers. Also, research laboratories who work with human organs (eg: checking the effect of a drug) are also included in our target customers.

4.2 Value Proposition:

Our product is highly trusted and cost effective. It is easily available with an efficient online payment system. Customers have to just open a profile on our website and then login with their credentials and order the products with address. We offer an effective customer feedback system.

4.3 Key Activities:

We will have effective partnership with the world's best 3D bioprinter manufacturing companies and store their products. An effective and efficient supply chain will be maintained so that availability of products is maintained preferably. We also will hire experts in managing bioprinters who will do regular servicing of the products supplied to the customers. Managing the website and periodically developing it to make it more customer friendly is also regarded as our key activity.

4.4 Channels:

Our marketing strategy is going to be fully digital and online mode based. Customers will be able to interact with us, order their product and share their review through our online website. They can also contact us via email and phone calls for any query.

4.5 Revenue Streams:

We are planning to keep multiple revenue streams such as online advertisements on our website. Revenue from Logistics will also be collected.

4.6 Cost Structure:

There are several streams that we have to invest money for. First of all, an amount will go for creating our website, buying server space, domain space and renewal values. Later on, it will be more and more improved and will be made customer friendly as possible. Another stream is to build the office and other necessary infrastructure related to the office and work. And of course, quite a good amount will go for the salary of the employees. In addition to this, the cost of marketing and shipment of bioprinters, warehousing and logistics cost are also included.

4.7 Key Resources:

Our key resources are factories manufacturing 3D bioprinters. The technology of manufacturing the machine and the technology of the process of how the machine produces a 3D organ is also important so that more efficient technology can be explored by modifying these technologies. As we'll provide delivery facilities also, the transport providers are also important key resources. The technicians who are expertised in operating and maintaining 3D bioprinters are also included.

4.8 Key Partners:

Factories manufacturing 3D bioprinters are our key partners, Also, hospitals, healthcare sectors, nursing homes who are interested in providing organ transplantation facilities, drug testing centres and other laboratories are our key partners.

4.9 Customer Relationship:

We will focus mainly on virtual mode to build relationships with our customers. As already said, they will be interacted through websites, phone calls or emails. In the website also they'll find customer support chat with instant reply. YORGAN will have facebook, instagram and twitter page also. 24x7 customer service is available through phone. We'll also focus on quickest customer complaint management as it is the main part of customer satisfaction.

5. Result:

The awareness about organ transplantation is quite limited in a country like India. The rate of organ donations is as low as 0.08% in India as compared to other countries^{1 5}. It is seen that nearly 0.5 million people lose their lives every year due to non-availability of organs^{1 6}. We conducted a survey to understand the current scenario of organ donations.

Here we can see that most of the hospitals with organ transplantation facilities are located in the urban areas indicating that many patients from rural or semi urban areas are deprived from this facility.

Organ donors are rarely available and as a result many patients lose their lives. Due to scarce availability of donors, the rate of yearly organ transplantation is also low.

From the above two survey results we can see that the main reason behind rejection of organs are the immunological rejections and also it becomes mandatory to take immunosuppressive drugs lifelong. Here comes the advantage of implementing organs generated from 3D-Bioprinters as these are made from a patient's own cells.

The rate of death cases due to unavailability of organs is more than 50. Thus, as an alternative to organ donation, organs generated through 3D Bioprinters can prevent many deaths.

6. Discussion:

Replacing the traditional donor based organ transplantation process by this exclusive technology will be a major way to save many lives. YORGAN is a platform to distribute this exclusive technology to every part of the country and solve the problems created by shortage of organs in hospitals or research labs. On the other hand, customers will be helped by regular service by the technicians and they are always welcome to contact us through emails, phone calls or our website customer support chat if any type of inconvenience is faced.

In the angle of business, it will be a very impressive and productive business as these 3D bioprinters are not available that much in the market, especially in India there is no startup regarding 3D bioprinters^{1 7}. If available also, Technical support platform is not at all available till now and so no customer support is available to help the customers. In this situation our company can be the unique and most reputed company to serve 3D bioprinters[17].

Primarily if the customers face any inconvenience, they are always welcome to share their feedback so that we can develop ourselves more and more.

7. Conclusion:

After analyzing the market of healthcare sector we have realised that there is no such system through which consumers can easily buy the 3D Bioprinter in various places across the India. Our Company YORGAN is the platform where "Your Organ Matters". For those places where we don't have our branch they can also buy this through our website[14]. Consumers feel safe with regards to their information which they have provided us during the time of registration. We created a website for the consumers in which consumers have to make an account of YORGAN and then only they can sign in to our website so this ensure the database security of the consumers. In the website they can link their location with our website where we will have to deliver the Bioprinter[13]. There are multiple options for payment-Cash on delivery, internet banking, Credit card etc. We have symmetric encryption which can ensure the security of the database of the consumers[16]. Therefore the main aim of our company is to preserve life and promote connectivity to provide accessibility for catering to the needs of mankind[15].

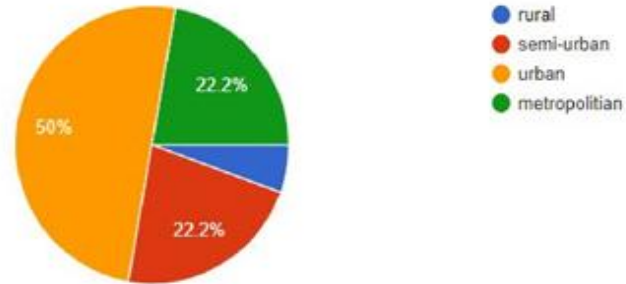
Table 1— Business Model Canvas

<p>CUSTOMER SEGMENTS</p> <ul style="list-style-type: none"> • Hospitals in demand for organ transplantation service • Nursing homes in shortage of organs for transplantation • Drug testing centers in need of organs 	<p>VALUE PROPOSITION</p> <ul style="list-style-type: none"> • Highly trusted products • Cost-effective and easy availability • Efficient online payment system • Effective feedback system • More successful rates of organ transplantation 	<p>COST STRUCTURE:</p> <ul style="list-style-type: none"> • Cost of website development • Office and infrastructure • Payroll expenses for the employees • Supplier acquisition cost • Marketing cost and shipment cost • Warehouse and logistics cost
<p>CUSTOMER RELATIONSHIPS</p> <ul style="list-style-type: none"> • Customer support chat • Social media • Complaint management • 24/7 active customer support 	<p>KEY RESOURCES</p> <ul style="list-style-type: none"> • Factories manufacturing 3D bioprinters. • Technology • Transport providers • Website management 	<p>KEY ACTIVITIES</p> <ul style="list-style-type: none"> • Partnerships with companies manufacturing 3D bioprinters • Hiring and managing transport providers • Hiring trained expertise to operate the bioprinters • Maintenance of websites • Managing delivery payment process
<p>REVENUE STREAMS</p> <ul style="list-style-type: none"> • Commission structures • Advertisements • Logistics • Convenience charges 	<p>KEY PARTNERS</p> <ul style="list-style-type: none"> • Factories manufacturing 3D bioprinters • Hospitals • Nursing Homes • Laboratories • Drug testing centers 	<p>CHANNELS</p> <ul style="list-style-type: none"> • Digital marketing • Websites • Emails • Phone Calls

Figures

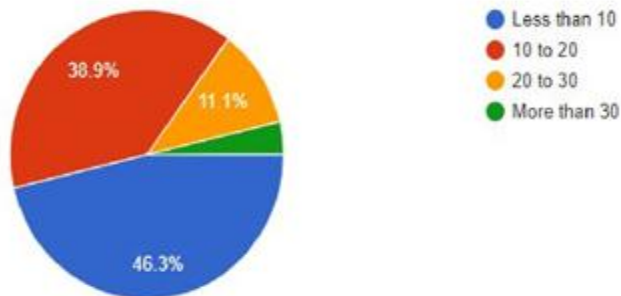
What is the location of your hospital?

54 responses



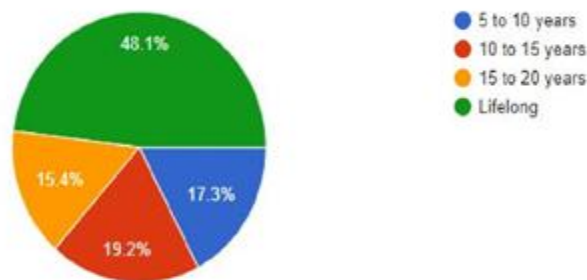
How many organ transplantation takes place yearly?

54 responses



For approximately how much time immunosuppressive drugs are taken by the patient who has undergone organ transplantation?

52 responses



In last five years approximately how many death cases occurred due to unavailability of organ donors?

54 responses

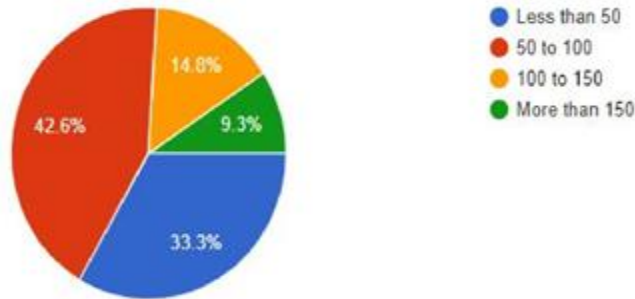


Fig.1: Responses from survey

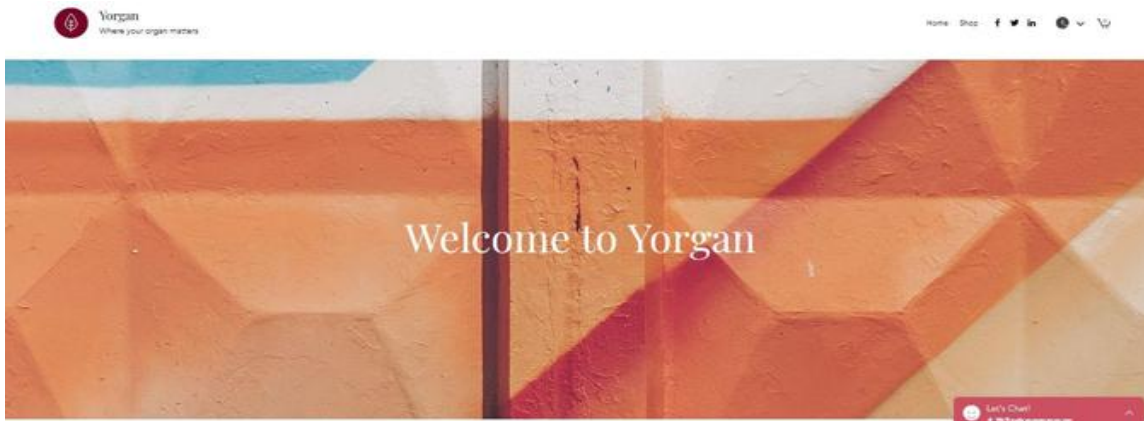


Fig.2: Website Homepage



Fig. 3: Products



Fig. 4: About us

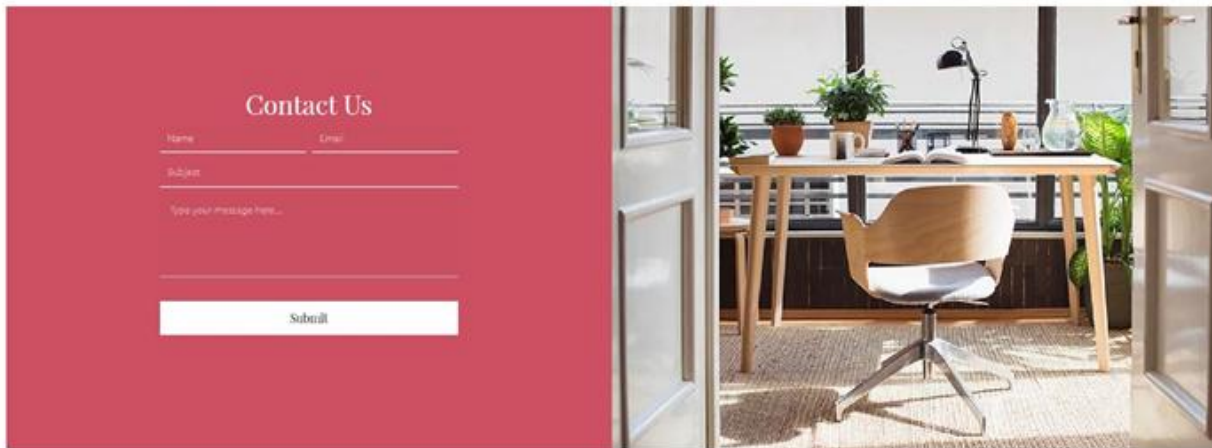


Fig. 5: Contacts

Home / Shop / Organovo's NovoGen MMX

< Prev | Next >



Organovo's NovoGen MMX

SKU: 364215376135191

₹1,400,000.00

Quantity

Add to Cart

Technology

syringe-based extrusion

Materials

Cellular hydrogels



Organovo's bioprinter works by taking cells from a research cell line, a patient, or other sources and growing them in a culture until enough cells are present. The cells are then collected and specially incubated in order to form bioink, consisting of cells and the building blocks to form a functional organ system in vitro. This is the beginning stage of solid tissue formation. The cell mixture is then loaded into a cartridge, which is placed into the printer. With a computer-programmed script, the printer deposits the tissue into a desired shape. The printed tissue is incubated for 48 hours or more to allow it to mature.



Fig. 6: Product details



Yorgan
Where your organ matters.

Home Shop     

My Cart



RegenHU's 3DDiscovery + Biofactory

₹1,400,000.00

Enter a promo code

Add a note



Order Summary

Subtotal ₹1,400,000.00

Shipping: FREE

West Bengal, India

Total ₹1,400,000.00

Checkout



Fig. 7: Buyer's cart page

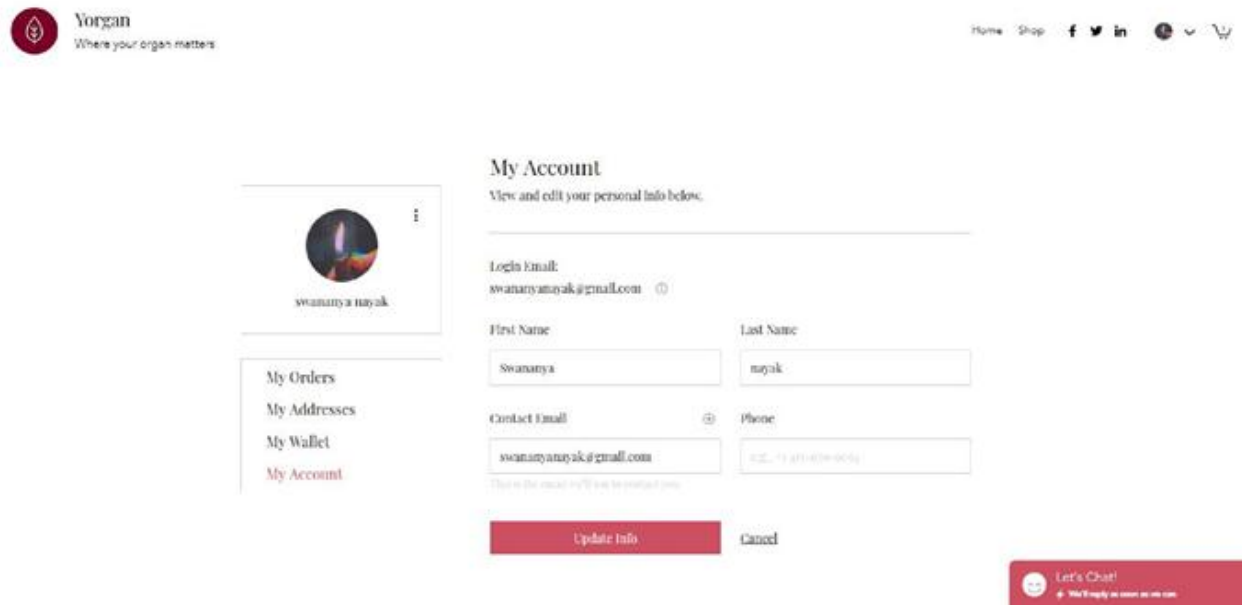


Fig. 8: Buyer's account page

References

- [1] Centola M, Rainer A, Spadaccio C, et al. Combining electrospinning and fused deposition modeling for the fabrication of a hybrid vascular graft. *Biofabrication*. 2010;2:014102. [PubMed] [Google Scholar]
- [2] Skardal A, Zhang J, Prestwich GD. Bioprinting vessel-like constructs using hyaluronan hydrogels crosslinked with tetrahedral polyethylene glycol tetracrylates. *Biomaterials*. 2010;31:6173–6181. [PubMed] [Google Scholar]
- [3] Itoh M, Nakayama K, Noguchi R, et al. Scaffold-free tubular tissues created by a bio-3d printer undergo remodeling and endothelialization when implanted in rat aortae. *PLoS One*. 2015;10:e0136681. [PMC free article] [PubMed] [Google Scholar]
- [4] Xiongfa J, Hao Z, Liming Z, Jun X. Recent advances in 3D bioprinting for the regeneration of functional cartilage. *Regen Med*. 2018;13:73–87. [PubMed] [Google Scholar]
- [5] Wang X, Ao Q, Tian X, et al. 3D bioprinting technologies for hard tissue and organ engineering. *Materials (Basel)* 2016;9:pii:E802. [PMC free article] [PubMed] [Google Scholar]
- [6] Izadifar M, Chapman D, Babyn P, et al. Uv-assisted 3D bioprinting of nanoreinforced hybrid cardiac patch for myocardial tissue engineering. *Tissue Eng Part C Methods*. 2018;24:74–88. [PubMed] [Google Scholar]
- [7] Hoch E, Tovar GE, Borchers K. Bioprinting of artificial blood vessels: current approaches towards a demanding goal. *Eur J Cardiothorac Surg*. 2014;46:767–778. [PubMed] [Google Scholar]
- [8] Wang Z, Liu Y, Luo H, et al. Is a three-dimensional printing model better than a traditional cardiac model for medical education? A pilot randomized controlled study. *Acta Cardiol Sin*. 2017;33:664–669. [PMC free article] [PubMed] [Google Scholar]
- [9] Christensen A, Rybicki FJ. Maintaining safety and efficacy for 3d printing in medicine. *3D Print Med*. 2017;3:1. [PMC free article] [PubMed] [Google Scholar]
- [10] An Introduction to 3D Bioprinting: Possibilities, Challenges and Future Aspects

Authors: Željka P. Kačarević, Patrick M. Rider, Said Al Kildani, Sujith Retnasingh, Ralf Smeets, Ole Jung, Zrinka Ivanišević, and Mike Barbeck

Published on: 2018 Nov 6

[11] Hull CW. Apparatus for production of three-dimensional objects by stereolithography. Google Patents. 1986;US 4575330 A [Google Scholar]

[12] Groll J, Boland T, Blunk T, et al. Biofabrication: reappraising the definition of an evolving field. *Biofabrication*. 2016;8:013001. [PubMed] [Google Scholar]

[13] Lee J, Sing S, Zhou M, Yeong W. 3D bioprinting processes: a perspective on classification and terminology. *Int J Bioprint*. 2018;4:151. [Google Scholar]

[14] Murphy SV, Atala A. 3D bioprinting of tissues and organs. *Nat Biotechnol*. 2014;32:773–785. [PubMed] [Google Scholar]

[15] Nakamura M, Iwanaga S, Henmi C, et al. Biomatrices and biomaterials for future developments of bioprinting and biofabrication. *Biofabrication*. 2010;2:014110. [PubMed] [Google Scholar]

[16] Zhang WJ, Liu W, Cui L, Cao Y. Tissue engineering of blood vessel. *J Cell Mol Med*. 2007;11:945–957. [PMC free article] [PubMed] [Google Scholar]

[17] Colunga T, Dalton S. Building blood vessels with vascular progenitor cells. *Trends Mol Med*. 2018;24:630–641. [PMC free article] [PubMed] [Google Scholar]