Special Report

3D Printing Technology

3D Printing (3DP): Opportunities In Healthcare

aranca

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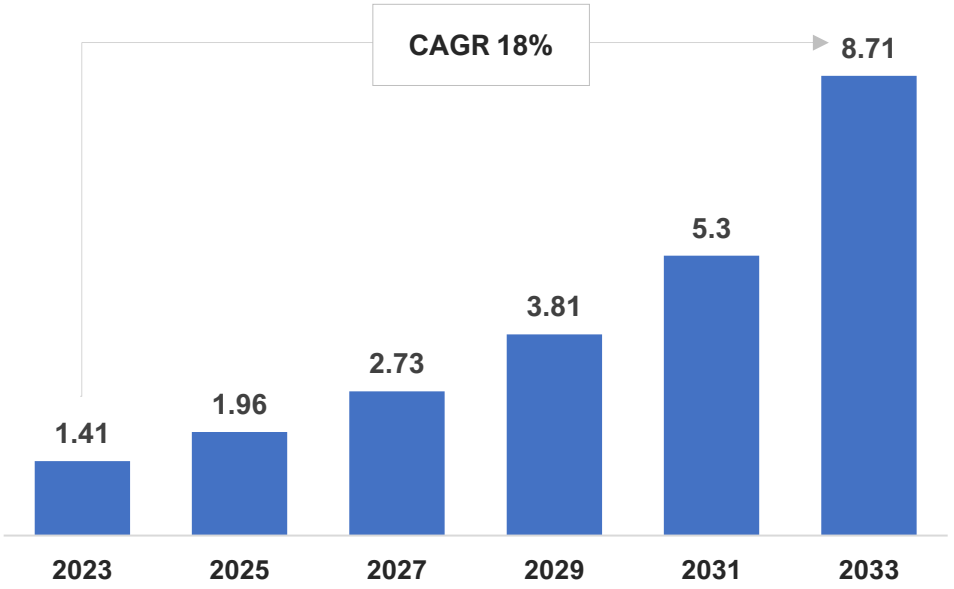
3D Printing Technology In Healthcare

The global 3D printing healthcare market is forecasted to grow from ~USD 2 Bn in 2025 to ~USD 9 Bn by 2033 at an 18% CAGR, driven by growth in personalized medicine, and biomedical innovation in the space

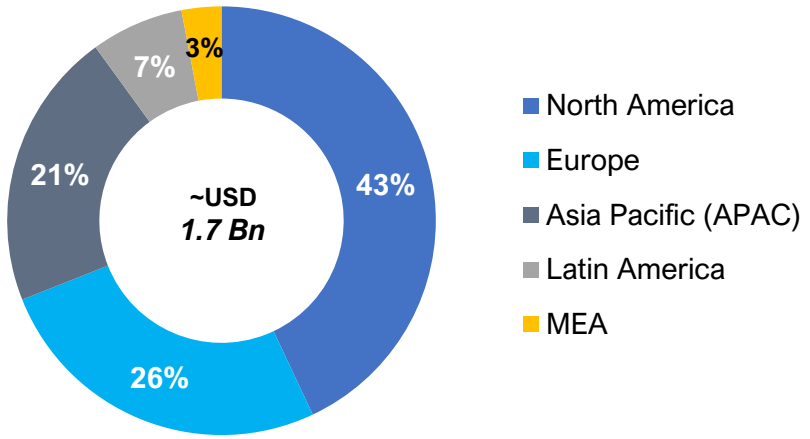
Market Size of 3D Printing in Healthcare

FY23-33F | Figures in USD Bn



3D Printing in Healthcare Market Share by Region

FY24 | Figures in Percentage



- 3D printing (3DP), also known as additive manufacturing, is driving a paradigm shift in healthcare through high-precision bio fabrication, enabling patient-specific prosthetics, anatomical modeling for surgical planning, customized medical devices, and on-demand pharmaceutical production.
- North America leads the wearable medical devices market with a 43% share as of 2023, driven by advanced healthcare infrastructure, high adoption of digital health technologies, and favorable reimbursement frameworks.
- Meanwhile, APAC is set to be the fastest-growing region, projected to expand at a CAGR of ~22% from 2025 to 2033, fueled by rising healthcare awareness, increasing geriatric population, and government investments in digital health initiatives.

Source: *Industry Reports, News Articles, Company websites, Aranca Analysis*

3D Printing In Healthcare – Growth Drivers

This accelerating growth of 3DP in healthcare is due to rapid tech innovation, rising R&D investments, growing demand for patient-specific solutions, and the shift toward personalized medical care

- The growth of 3D printing in the healthcare sector is driven by technological advancements, increased R&D investments, rising healthcare demand, and the growing need for personalized medicine.
- The ability to create patient-specific implants and prosthetics plays a pivotal role in revolutionizing treatment approaches and improving patient outcomes.

Technological Advancements

Rapid innovation in 3DP technologies has improved disease modeling, surgical planning, and prosthetic development, driving wider adoption in healthcare.

A 2024 Jaycon article highlights a breakthrough in 3D-printed vascular tissues, AI integration improved graft success & durability.

In 2024, L'Oréal, in collaboration with the University of Oregon, developed bioprinted skin capable of simulating sensory feedback.

Increased R&D Investments

Major players are heavily investing in R&D to develop cutting-edge 3DP materials, biocompatible products, and advanced printing techniques, driving market growth.

In the first quarter of 2025, Materialise NV increased its research and development (R&D) investments by nearly 12% compared to the previous year

Expanding Healthcare Demand

The growing demand from hospitals, research institutes, and diagnostic centers for precise, patient-specific solutions is significantly boosting the adoption of 3DP.

Mayo Clinic has expanded its 3DP operations, with its Rochester facility now covering 8,000 sq. ft. and 15 3D printers, reflecting the growing demand.

Rise of Personalized Healthcare

The demand for personalized medical solutions like implants, prosthetics, and surgical guides is improving patient outcomes and satisfaction.

Personalized healthcare is expected to grow at a 9% CAGR, driven by advancements in genomic research, rising chronic diseases, and a shift toward tailored treatments.

Source: *Industry Reports, News Articles, Company websites, Aranca Analysis*

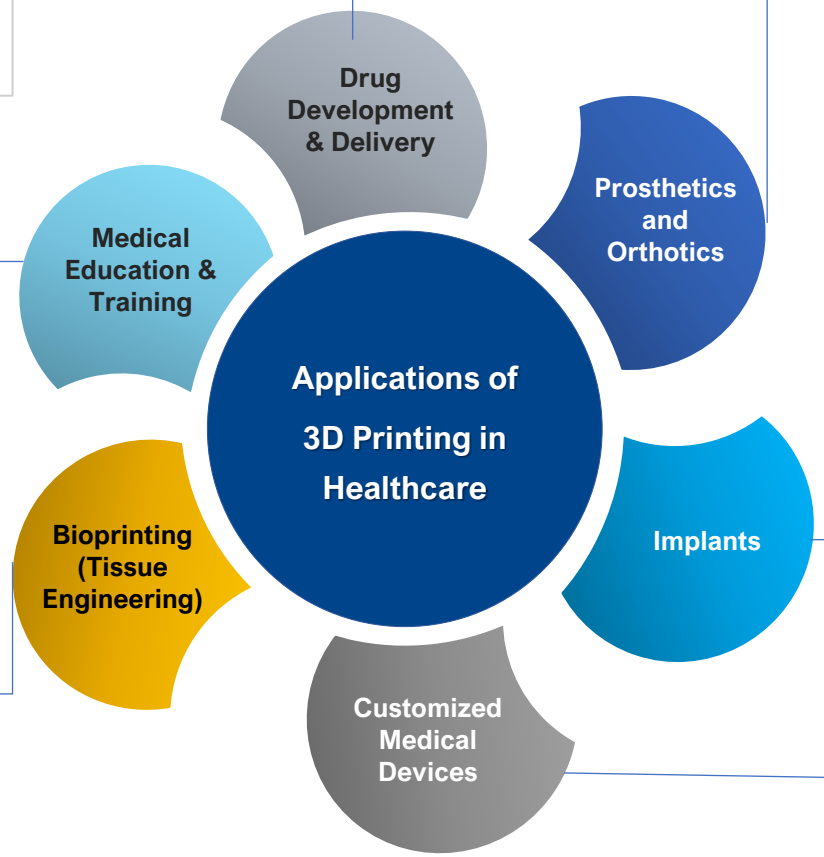
3D Printing In Healthcare – Applications Overview

3DP in healthcare enables customized prosthetics, patient-specific implants, surgical planning models, innovative drug delivery systems, and emerging bioprinting of tissues, driving precise, personalized, and cost-effective therapies

Researchers have developed **dissolvable 3D-printed microneedle arrays** that deliver **cisplatin** directly into the skin, enabling controlled release with effective preclinical anti-cancer results.

Researchers at University of Texas at Dallas have developed cost-effective, patient-specific **3D-printed femur models** to aid in orthopedic surgical training.

The Mayo Clinic has developed **bio-printed skin models** to study inflammatory skin diseases, providing a platform to test treatments and understand disease progression.



Syntellix AG has emerged as a global frontrunner in **bioabsorbable orthopedic implants**, with its MAGNEZIX magnesium-based screws gaining regulatory approval in over 58 countries.

In 2024**, 3D Systems** achieved FDA clearance for patient-specific cranial implants made from PEEK (polyether ether ketone). Over 60 successful cranioplasties have been performed using these implants, showcasing their effectiveness in personalized care.

Stratasys J5 Digital Anatomy Printer: Introduced in 2024, this printer produces highly realistic anatomical models, aiding in surgical planning and medical education.

Source: *Industry Reports, News Articles, Company websites, Aranca Analysis*

3D Printing In Pharmaceuticals

3DP is transforming pharma applications by enabling personalized dosing, on-demand manufacturing, complex drug release forms, & advancing patient-specific therapies through innovators like Aprecia, Triastek, & BioSapien

Pharmaceutical Applications

Personalized Dosing

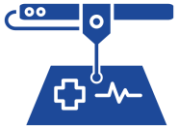
- 3DP enables patient-specific pills with tailored release profiles, as seen with **Aprecia's SPRITAM**, the first FDA-approved 3D-printed tablet, using **ZipDose** (Aprecia's 3DP platform) technology to create a fast-dissolving, high-dose epilepsy medication

On Demand Manufacturing

- 3D printing enables on demand and on-site production of personalized, small-batch medications in hospitals and pharmacies, reducing waste and improving access
- In 2022, Helsinki-based CurifyLabs partnered with Barcelona's Natural Machines to develop a 3D printing platform for producing personalized drug treatments

Complex Release Forms

- **Triastek's T20G**, a 3D-printed anticoagulant, uses a gastric-retentive microstructure to enable sustained release in the upper GI tract
- T20G received FDA IND approval in 2025, demonstrating regulatory acceptance of micro-architectured, personalized drug delivery platforms



Current Players

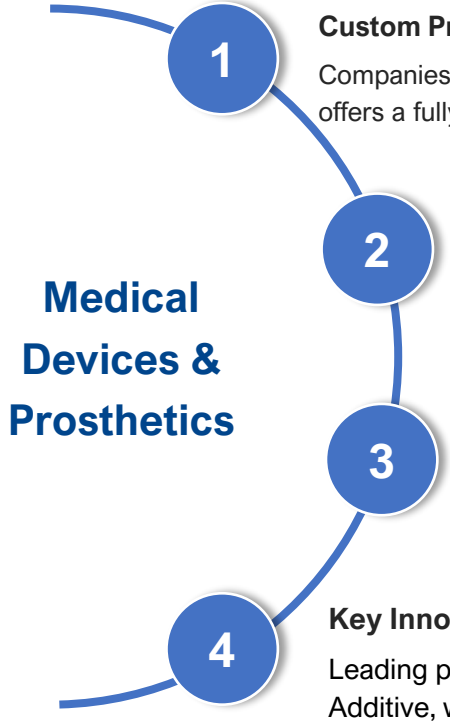
- Leading innovators like **Aprecia, Triastek, FabRx**, and **BioSapien** are pioneering 3D-printed drug technologies, advancing personalized medicine through on-demand, patient-specific therapies
- FDA and EMA are evaluating guidance, having already classified 3DP drugs under existing drug regulations

Source: *Industry Reports, News Articles, Company websites, Aranca Analysis*

3D Printing In Medical Device and Prosthetics

3DP is revolutionizing medical devices and prosthetics by enabling affordable, personalized, and scalable solutions using advanced materials and streamlined production workflows

- 3D printing enables cost-effective, sterilizable, and highly customizable prosthetics tailored to individual anatomy, improving accessibility and clinical usability worldwide for both medical devices and prosthetics
- The orthopedic 3D-printed devices market is a major segment in 3DP and is expected to grow at a CAGR of ~17% by 2028, with North America accounting for 40% of this growth



Custom Prosthetics

Companies like Unlimited Tomorrow use full-color nylon printers to fabricate prosthetic arms and limbs. Their product **TrueLimb** offers a fully 3D-printed, custom-fit prosthetic arm for ~$8K to ~$50K significantly lower than the cost of traditional options

Materials Innovation

Advanced biocompatible materials and multi-material printing enable 3D-printed devices to mimic tissue properties, support sterilization, and produce porous implants and realistic anatomical models

Scale and Production

Medical-grade 3D printing is scaling, with hospitals and manufacturers enabling rapid (e.g. custom splints, dental guides), small-batch production of patient-specific devices through streamlined scan-to-print workflows

Key Innovators

Leading players in medical 3D printing include Materialise(Belgium), Stratasys(USA/Israel), 3D Systems, EOS, and GE Additive, with startups like Cellink, Formlabs, and Markforged also advancing healthcare-specific applications

Source: *Industry Reports, News Articles, Company websites, Aranca Analysis*

3D Printing In Surgical Planning and Imaging

3DP is transforming surgical planning & imaging through use of patient-specific anatomical models & AR/VR-enhanced visualizations, while promoting interdisciplinary collaboration, leading to improved accuracy & reduced risks

3D printing has significantly transformed surgical planning by enabling the creation of patient-specific anatomical models from CT and MRI data. These models facilitate enhanced visualization, precise preoperative rehearsal, and improved communication among surgical teams and patients

3DP anatomical models of bones, vessels, or organs from patient CT/MRI data help surgeons visualize complex structures and plan cuts, screw trajectories or resections physically and more accurately, improving results in cases like brain surgery

Preoperative rehearsal using patient-specific 3DP models improves surgical accuracy and has been shown to reduce operation time (~42%), blood loss (~47%), & radiation exposure (~93%), especially in orthopedics, neurosurgery, & cardiovascular procedures, according to a review article

3DP **workflows foster collaboration** between radiology, engineering, and surgical teams, using tools like Mimics and 3D Slicer to convert scans into STL models, enhancing surgical planning, print accuracy, and patient understanding during consent discussions

Advanced visualization combines 3DP with AR/VR, enabling surgeons to overlay holograms on printed models & collaborate remotely via mobile apps and cloud platforms for enhanced surgical planning.

E.g., the Cleveland Clinic, which has integrated 3DP with Microsoft HoloLens for mixed-reality surgical planning

- A systematic review found that 82% of studies on 3D printing and preoperative planning noted better surgical outcomes when 3D-printed models were employed instead of standard preoperative planning. More than 50% of studies in the review demonstrated a decrease in operation duration.
- Stanford Medicine, which uses **AR-enhanced 3D-printed models** to plan pediatric heart surgeries. The AR interface helps visualize internal structures that are not visible on physical models alone
- Uteshiya Medicare reported, in 2022, a study demonstrated that using 3D-printed heart models for surgical planning reduced surgery times by up to 25%, leading to improved patient outcomes and decreased surgical risks

Source: *Industry Reports, News Articles, Company websites, Aranca Analysis*

3D Printing In Healthcare – Competitive Landscape

Global leaders like Materialise, Stratasys, and 3D Systems are driving 3D printing in healthcare, with strategic collaborations (e.g., Varian HP Adaptiiv, Novartis MIT) accelerating personalized and on-demand medical solutions

Company	Country	Specialization
materialise	Belgium	Medical imaging software and custom device planning
stratasys	USA/Israel	Multi-material 3D printers for medical modeling and surgical applications such as **J5 MediJet**
3D SYSTEMS	USA	3D printers and surgical planning solutions, including Virtual Surgical Planning (VSP)
eos	Germany	Metal 3D printing systems for orthopedic and dental implants e.g., Direct Metal Laser Sintering (DMLS)
RENISHAW apply innovation™	UK	Metal additive manufacturing systems such as RenAM 500M, for producing patient-specific implants

Company	Collaboration
varian A Siemens Healthineers Company / hp / ADAPTIIV ON DEMAND	Varian (Siemens) teamed with HP and Adaptiiv to 3D-print patient-specific bolus devices for cancer radiotherapy
NOVARTIS / MIT	Novartis/MIT on on-demand printing, and FDA co-funded projects on 3DP pharma

Source: *Industry Reports, News Articles, Company websites, Aranca Analysis*

3D Printing In Healthcare – Future Outlook

The future of 3DP in healthcare is being shaped by AI-driven design, decentralized manufacturing, innovation hubs, & emerging technologies like 4D printing & smart surgical tools, paving the way for personalized & precision medicine

AI & Digital Convergence

- Artificial intelligence will increasingly optimize 3DP healthcare
- Example include AI-driven design of patient-specific implants and AI-optimized print parameters
- Digital twins and simulation tools will merge with 3DP
- E.g., AI might predict ideal lattice structures or patient outcomes from custom devices

Decentralized Manufacturing

- Hospitals now are producing patient-specific models implants in-house
- Regulators are drafting frameworks to support on-demand, site-specific drug and device manufacturing
- FabRx has developed a 3D printer “M3DIMAKER” to automate capsule production in community pharmacies

Innovation Hotspots

- 3DP in healthcare is driven by innovation hubs in Silicon Valley, Paris, and shanghai, leading to breakthroughs in personalized implants, prosthetics, and treatment planning.
- Government programs such as EU’s “Bio Fabrication Corridor” and China’s “Made in China 2025” are funding R&D to support the growth of this sector.

Emerging Technologies in 3DP

- Emerging trends include 4D printing, smart implants with embedded sensors, and bio-inks for tissue engineering
- Integrating 3DP with robotics and AR will enable fully digital surgical workflows
- These technologies will reinforce 3DP’s role in personalized and precision medicine

Source: *Industry Reports, News Articles, Company websites, Aranca Analysis*

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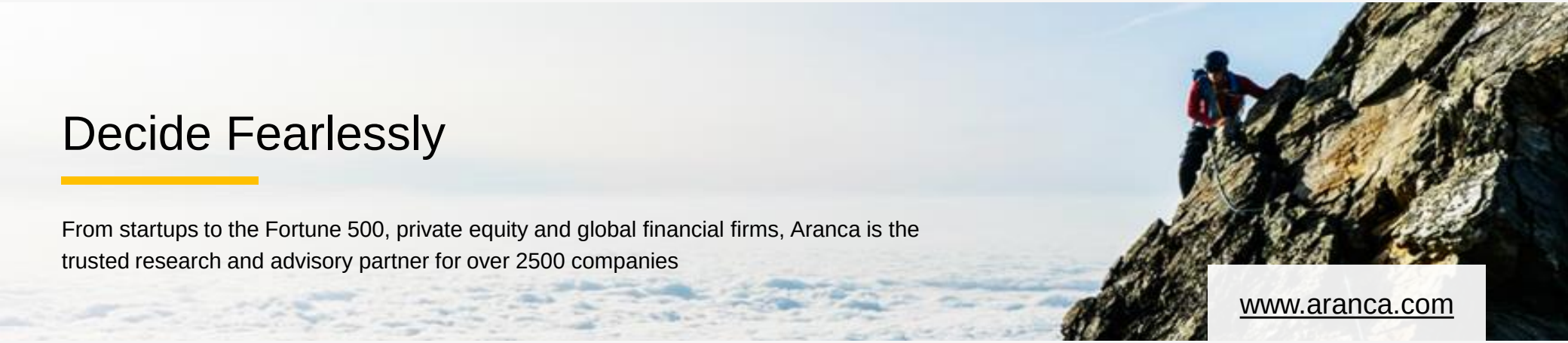

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