OPEN ACCESS Freely available online

Journal of Applied Pharmacy

Commentary

3D Printing of Personalized Solid Dosage Forms: A Practical Approach in Hospital Pharmacies

Jonathan P Clarke*

Department of Clinical Pharmacy, George's University Hospital, London, United Kingdom

ABOUT THE STUDY

The advancement of digital manufacturing technologies, particularly 3D printing, has revolutionized the pharmaceutical landscape by offering a feasible route to develop personalized medicines tailored to individual patient needs. In hospital pharmacy settings, where therapeutic regimens often require rapid and specific adjustments based on patient age, weight, organ function, or co-existing conditions, traditional mass production models fall short. The application of 3D printing, also known as additive manufacturing, allows for the fabrication of solid dosage forms with precise drug loading, customizable release profiles, and individualized shapes and sizes, thus aligning perfectly with the paradigm of personalized medicine. This study explores the practical implementation of 3D printing technologies in hospital pharmacies, with a focus on feasibility, formulation considerations, regulatory readiness, and clinical impact.

In the hospital environment, where medication errors and compliance issues remain significant challenges, 3D printing offers the ability to create polypills single tablets containing multiple drugs with separate release characteristics or to tailor doses for pediatric, geriatric, and renal-compromised patients. Fused Deposition Modeling (FDM) and semi-solid extrusion are among the most commonly adopted techniques within hospital-based applications due to their relative affordability, ease of use, and compatibility with pharmaceutical-grade excipients. Using pre-formulated drug-loaded filaments or paste-like drug mixtures, pharmacists can produce patient-specific tablets on-demand in a matter of minutes. These tablets can be engineered not only for dose precision but also for modified-release behavior, enabling better therapeutic outcomes with fewer dosing frequencies.

Commercial tablets were either too high in strength or unsuitable in form, leading to frequent dose adjustments and compounding inconsistencies. With the aid of a Computer-Aided Design (CAD) interface, clinical pharmacists generated digital models for tablets of various dosages, followed by successful fabrication using FDM printing with thermoplastic polymers such as Polyvinyl Alcohol (PVA) and hydroxypropyl cellulose. The printed tablets demonstrated uniform drug content, rapid disintegration, and acceptable mechanical strength, meeting pharmacopeial standards.

Beyond formulation, the implementation of 3D printing in a hospital setting required strict attention to operational workflow, hygiene, and quality control. A clean workspace, temperature control, and standardized operating protocols were established to ensure reproducibility and safety. Pharmacists underwent specialized training to understand printer calibration, material handling, and in-process testing. Collaboration with clinicians was vital to integrate these personalized dosage forms into patient treatment plans, and informed consent was obtained from all recipients of the 3D-printed medications during the trial phase.

Stability studies indicated that 3D-printed tablets retained drug content and structural integrity over a four-week observation period under ambient storage conditions, suggesting practicality for short-term inpatient use. The tablets also offered the possibility of integrating patient-specific identifiers, such as names or QR codes, which enhanced safety by reducing the risk of medication mix-ups. Feedback from patients, nurses, and prescribers was overwhelmingly positive, particularly regarding the ease of administration in children and the elderly.

The broader implications of 3D printing in hospital pharmacies include improved medication safety, waste reduction, and better inventory control. Unlike traditional tablet manufacturing, which relies on large batches and long shelf lives, 3D printing enables real-time production, reducing dependence on large inventories and minimizing drug wastage due to expiration or overstock. Additionally, the ability to print tablets in variable shapes and colors can aid in differentiating medications and improving adherence among visually impaired or cognitively challenged patients.

Despite its advantages, widespread adoption of 3D printing in hospital pharmacies still faces certain barriers. Regulatory guidance remains limited, though agencies like the MHRA in the UK and FDA in the US are increasingly acknowledging the role of 3D printed medicines in future pharmaceutical practices.

Correspondence to: Jonathan P Clarke, Department of Clinical Pharmacy, George's University Hospital, London, United Kingdom, E-mail: j.clarke@sguh-uk.ac.uk

Received: 03-Feb-2025, Manuscript No. JAP-25-37595; **Editor assigned:** 05-Feb-2025, PreQC No. JAP-25-37595 (PQ); **Reviewed:** 19-Feb-2025, QC No. JAP-25-37595; **Revised:** 26-Feb-2025, Manuscript No. JAP-25-37595 (R); **Published:** 04-Mar-2025. DOI: 10.35248/1920-4159.25.17.460

Citation: Clarke JP (2025). 3D Printing of Personalized Solid Dosage Forms: A Practical Approach in Hospital Pharmacies. J Appl Pharm.17:460.

There is also a need for cost-benefit analyses to evaluate whether the savings from improved adherence and reduced waste can offset the investment in 3D printers, raw materials, and staff training. Nevertheless, as technology becomes more affordable and accessible, these barriers are expected to diminish.

In conclusion, the integration of 3D printing into hospital pharmacy operations marks a significant step toward achieving truly personalized medicine. It empowers pharmacists to respond quickly and precisely to individual patient needs, particularly in complex or sensitive populations. While current applications may be limited to select cases and trial phases, the evidence from this practical approach demonstrates that hospital-based 3D printing of solid dosage forms is both feasible and impactful. With ongoing regulatory support, technological refinement, and interprofessional collaboration, 3D printing is poised to become an indispensable tool in the hospital pharmacy toolkit, bridging the gap between standard pharmaceutical manufacturing and patient-centered care.