FIP VIRTUAL EVENT SEP 2020

THREE-DIMENSIONAL PRINTING: A new approach for the manufacture of individualized medicines

S. FIGUEIREDO[1], P.C. DUARTE[2], A. BRÍZIO[3], F. GODINHO CARVALHO[3], A.I. FERNANDES[4] and J.F. PINTO[1]

[1] iMed.Ulisboa – Research Institute for Medicines, Universidade de Lisboa, Lisboa, Portugal; [2] Associação Nacional de Farmácias – Lisboa, Portugal; [3] Infosaúde – LEF, Barcarena, Portugal; [4] CiiEM – Interdisciplinary Research Center Egas Moniz, Instituto Universitário Egas Moniz, Caparica, Portugal

iMed. ULisboa Instituto de Investigação do Medicamento

CENTRO DE INVESTIGAÇÃO INTERDISCIPLINAR EGAS MONIZ

LEF

INTRODUCTION

Three-dimensional printing (3DP) has been recently acknowledged as an opportunity to make a significant technological leap over traditional pharmaceutical manufacturing processes and to promote a digital revolution within healthcare [1].

3DP technology, which comprises a variety of 3D-printing techniques, stands out for its applications [2-5]:

- Production of dosage forms on demand, with a specific and precise dose;
- Incorporation of multiple active pharmaceutical ingredients (APIs) into a single dosage form;
- Modulation of the drug release kinetics by tailoring the shape, size and structure of the printed dosage forms;
- Manufacture of complex dosage forms with API multidoses and tailored release profiles;
- Ability to manufacture a dosage form containing a liquid or semisolid embedded in a solid structure.

AIM

This work aims at evaluating the advantages and drawbacks of implementing 3DP technologies in community pharmacies, towards patient centric manufacturing of medicines and as an add value to the current dispensing and counselling practice.

METHOD

The state of the art was reviewed in different perspectives, using a **SWOT analysis** (Strengths, Weakness, Opportunities and Threats) as an embodiment of the existing information and projecting 3DP into the long term future.

RESULTS

Strengths

- Design and development of individualized medicines with flexible and precise dosages for patients with chronic or rare diseases (e.g. orphan drugs);
- Design *ab initio* of medicines for specific patient groups (e.g. pediatric and geriatric populations) or patients with specific problems (e.g. kidney or hepatic impairment);
- Manufacturing of medicines closer to patients;
- Manufacturing advantages of medicines compared to traditional industrial manufacture (e.g. scale up not required, flexibility on dosing and drugs' association);
- Eligibility for implementation in compounding pharmacies;
- Increased role of pharmacists in patient care;
- Overall promotion of pharmacists as service providers.

Weaknesses

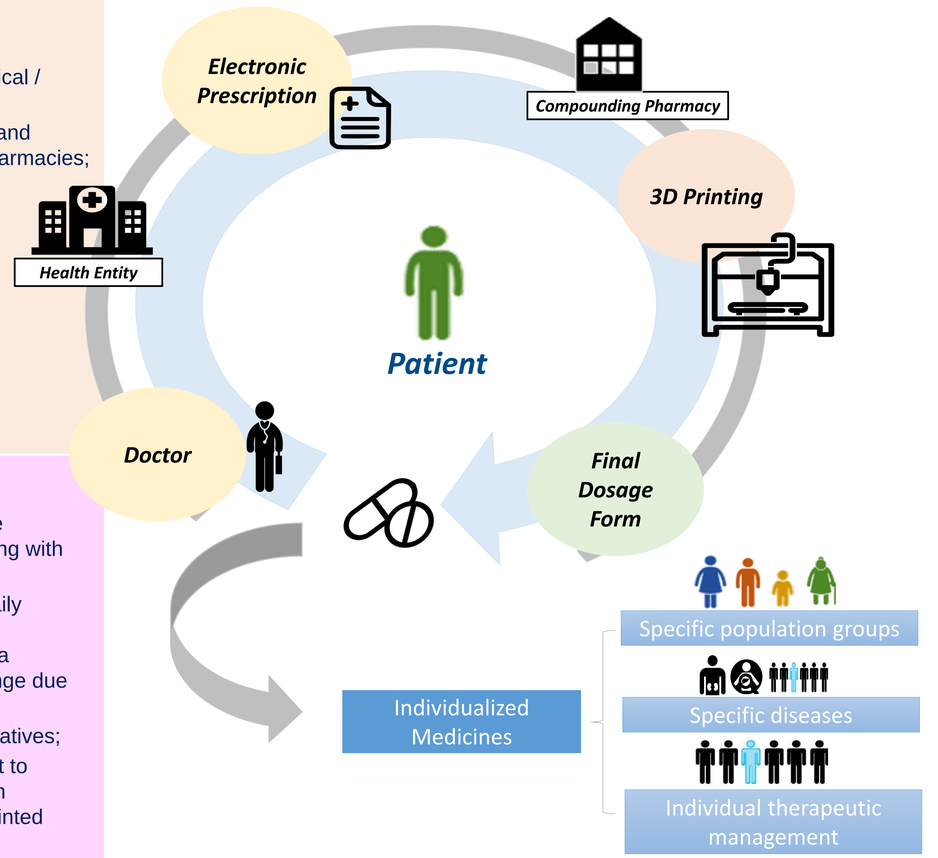
- Requirement of trained personnel and technical / technological qualified resources;
- Initial investment in equipment (e.g. printer) and software (e.g. licensing) by compounding pharmacies;
- Running costs may increase;
- Daily professional practice must change;
- Specialization of compounding pharmacies.

Opportunities

- 3DP re-centers compounding pharmacy, increasing the value of this activity;
- Better interconnection between manufacturing and pharmaceutical advice;
- Improved relationship between pharmacists and patients throughout the manufacturing process;
- Higher involvement of patients and patients' associations in the usage of medicines;
- Large benefits in compliance and health literacy.

Threats

- Co-participation and deep involvement of the medical and pharmaceutical classes in dealing with prescriptions for 3DP medicines;
- Physicians and pharmacists must change daily practice since medicines are designed, manufactured and prescribed for patients in a different way (prescribing practice must change due to complete freedom);
- Lack of expertise may compromise early initiatives;
- Stakeholders related to medicines may resist to changes (e.g. Health Authorities need to gain evidence on quality, safety and efficacy of printed medicines).



CONCLUSIONS

Emergent 3DP can potentially contribute to better patient driven medicines since individualized medicines improve adhesion, safety and efficacy without sacrificing the quality of existing therapies.

Although the application of the technology is at its early stages, one can anticipate a promising future with a fast implementation and use of this novel medicines, profiting from a favorable environment (e.g. industry 4.0, nanotechnology, patient and patients' associations higher involvement in health care management).

Stakeholders in the pharmaceutical area are, through research, paving the way to readily available medicines, tailored according to the patient's need, thus reinforcing the pharmacist role as a healthcare provider.

REFERENCES

[1] Ursan I.D. et al. Three-dimensional drug printing: A structured review. *J Am Pharm Assoc 2013; 53: 136–144.*

[2] Alomari M. et al. Personalized dosing: Printing a dose of one's own medicine. *Int J Pharm 2015; 494: 568–577.*

[3] Goyanes A. et al. Effect of geometry on drug release from 3D printed tablets. *Int J Pharm 2015; 494: 657–663.*

[4] Zhang J. et al. Coupling 3D printing with hot-melt extrusion to produce controlled-release tablets. *Int J Pharm 2017; 519: 186–197.*

[5] Beck R.C.R. et al. 3D printed tablets loaded with polymeric nanocapsules: An innovative approach to produce customized drug delivery systems. *Int J Pharm 2017; 528: 268–279.*

ACKNOWLEDGEMENTS

Fundação para a Ciência e a Tecnologia, Lisbon (PT) supported this work (PTDC/CTM CTM/30949/2017 | Lisboa-010145-Feder-030949 and SFRH/BD/146968/2019).

LEF - Infosaúde supported the participation in the FIP Virtual Event 2020.

CONTACT INFORMATION

Correspondence: sara.figueiredo@ff.ulisboa.pt or jfpinto@ff.ul.pt