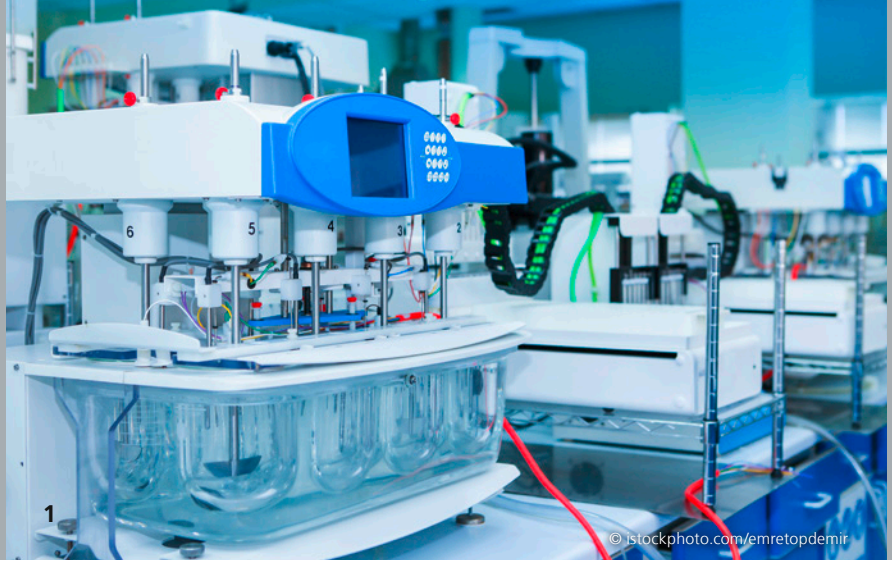

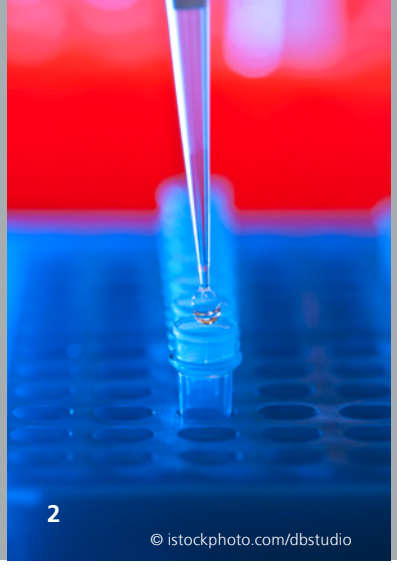

PERSONALIZED MEDICINE – METHODS FOR PRODUCTION PLANNING

Personalized therapies are new and promising trends for the treatment of many diseases. They have been proven exceptionally effective in low scale tests. However, in order to succeed economically, the production processes need to be scaled to an industrial level. They need to be secure, cost efficient and last, but not least, fast. After all, long waits will be unacceptable for patients – especially in life and death situations. Therefore, it is of the essence that the production is planned and executed optimally.

1 *Laboratory equipment*

2 *Pipetting a DNA solution*

Challenges of bio-processes

Bio-processes show characteristics that complicate the optimal design and efficient management of industrialized processes.

- High quality standards often call for re-executing process phases for individual patients.
- Heterogeneous processing times complicate the development of a periodic production flow.
- The probabilistic nature of processing times and error occurrence prevent a structured, predictable workflow.

Approaches for process optimization

First, we can get a better understanding of the processes by carefully studying the capacities of different process phases, especially those with high failure rates. For example: In which period should a patient ideally arrive so there are no long waiting times? Knowing this, we can align process phases and determine where to keep additional production capacities ready to compensate for workload spikes. Furthermore, the purchase of more or better devices can be evaluated.

In order to avoid frequent changes to the production plan, we can add puffer times between production steps. Thereby, we can limit the impact of delays to a small part of the process and it is possible to set up a periodic production schedules: For every process section, we determine when best to start and how many patients should roughly be processed at the same time. The resulting schedule is more stable, although errors and probabilistic processing times still cause some variance.

These are just two examples of how we analyze the individual challenges of bioprocesses and develop new methods to manage and optimize workflows. Using digital twins of the processes, we assess our strategies and simulate the interactions of different ideas.