Forum on Regenerative Medicine

Workshop on Navigating the Manufacturing Process and Assuring the Quality of Regenerative Medicine Therapies

Session 3: DESIGNING TECHNOLOGIES TO MEET THE MANUFACTURING NEEDS OF NEW REGENERATIVE THERAPIES

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June 26, 2017
Scaling Personalized Cell Therapy Manufacturing

**Current State**

Cell therapy manufacturing today is:
- Manual
- Complex
- Too many avoidable failures

- “Zero tolerance for failure” → “Every patient dose counts”

**Near-term State**

Predicted Scale-Out

- The “window” to address challenges

**Desired State**

Cell Therapy Manufacturers want...
- operational excellence
- compliance
- a safe & effective

…cell therapy manufacturing solution to meet their scale-out needs

The ecosystem needs to evolve to treat patients “on demand”
Predicting where the industry is going has huge impact on cell and gene therapy manufacturing.

Risk per Dose

Patients Treated

Ad hoc equipment, processes, and reagents

Next generation tools, therapies, and processes

Global manufacturing & franchising

Clear reimbursement paths and clinical uptake

Analytics, automation and the end of the clean room

Better therapies through improved potency and transplant efficiency

2017  2020  2025  2030

Trend Summary

- 2-3 CAR-T market BLA’s expected in 2017
- Insufficient global manufacturing capacity today
- Clinical/manufacturing/supply chain integration needed (Vitravian)

- CAR-T COGS per dose greater than $100K US
- Major cost driver - viral production adds $10 to $20K per dose
- Specialized labor intensity

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Challenge - It takes years and huge investment to bring new platforms to market

Innovation Loop

- Intellectual Capital and Core Technologies
  - Alternative monetization opportunities
  - Products and Services

Product Care Loop

- Corporate Funding
- Ideas Expertise
- Prototypes
- Ventures
  - Know-how & Investment
- CRO Services
- IP
- Business Funding
- BD Deals
- NewCos
- Products
- Services
- Therapies
- Royalties

TRL Level

1. Research
   - Idea
   - Basic research
   - Technology formulation and proof of concept

2. Early Development
   - Small scale prototype(s)
   - Large scale prototype(s)
   - Integrated system prototype

3. Late Development & Launch
   - Demonstration system
   - First of kind commercial system
   - Full commercial launch

3 – 7 Years
$1 – $25 Mio

Close this gap!
Industrialization pain points are continually shifting

- Reagents and consumables are not produced at scale today, but will be
- Equipment capex is not a major driver at scale, but service and support will be increasingly critical
- Manufacturing capacity is not optimized
- Labor and lack of automation is major pain point still

- Equipment cost estimates based on a per patient basis. Revenue opportunity based on customer device demand is not fully represented
- ** Digital connectivity and Vinetii are captured here
Everything (almost) depends on dose size

Either, grow **more** cells cost effectively…

Or, find a way to use **fewer** of the “right” cells…

Convert to allogeneic universal cells

Select, enrich, or engraft
Tool development is necessarily a compromise between bespoke unit operations and a one-size solution.

Pros:
- Precision & control
- Flexibility & adaptability
- Expandability

Cons:
- Complexity
- No standards
- Interoperability

Pros:
- Simplicity (?)
- Connectivity
- Automation
- Standards

Cons:
- Flexibility
- Performance
- Cost efficiency
Miniaturize, close & automate … “Cell therapy in a box”

Factory in a box(es) vision: 100+ step manufacturing process simplified
Connecting it all with a “Core to Cloud” robust supply chain

@ People

Predix Edge Device

Asset Performance Management (DASHBOARDS)

GE & Non-GE

Unit Operations

Equipment Data

Process Data

MFG Workflow

Unit Operations

Equipment Visibility

Consumable Visibility

@ Devices

@ Process

@ Ecosystem

Connect with Ecosystem

Integration with Enterprise

ERP, LIMS, eBR, etc.

Predicate

Edge Device

Predix Edge Device

Connecting it all with a "Core to Cloud" robust supply chain
We recognize that new, fit-for-purpose platforms & services are required to make cell therapy a widespread reality.

**Key trends:**

**Personalization of medicine**
- Dependence on genomic / metabolomic information
- Tailoring of therapies to individuals
- Big data emergence

**Increasing complexity of medicines / therapies**
- Increased dependence on technology
- Automation and digitization
- Deep biological understanding

**Convergence of clinical and manufacturing pathways**
- Destination medicine
- Changes in logistics management
- Complexity of supply chain
- Medical devices

**Implications:**

Today, we have a sector with no clear integrator…