

#### Agenda

- Introduction to the Cell and Gene Therapy Catapult
- What are cell and gene therapies?
  - Clinical impact
  - Supply chain terminology
    - Auto, allo, vector
  - Industry growth/potential
- Challenges current supply chain
- Opportunities future supply chain



## Why cell and gene therapy

01

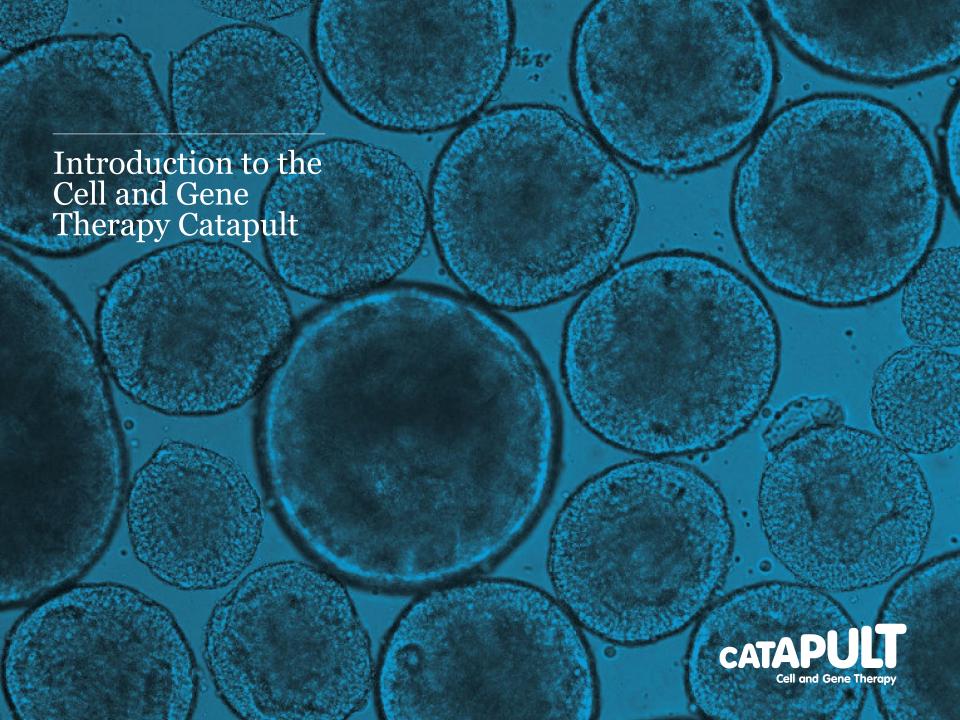
Identified significant and growing unmet healthcare needs that cell and gene therapy could address 02

The UK is at the leading-edge of the cell and gene therapy industry.

03

An opportunity to build a large-scale industry delivering health and wealth to the UK.





#### The Catapults

- Part of a world-leading network of technology and innovation centres
- **Bridge the gap** between businesses, academia, research and government
- Access technical facilities and expertise to help adopt, develop and exploit innovations
- Established by Innovate UK



Growing the UK cell and gene therapy industry, delivering health and wealth.

"



#### Everything you need under one roof

Our capabilities complement each other across the cell and gene therapy lifecycle

#### Safe and effective

Non-clinical safety



Clinical operations



Regulatory expertise



Industrialisation

#### Scalable

Investment in infrastructure -GMP facility and state-of-the-art laboratories



Regulatory expertise



Industrialisation

#### Affordable

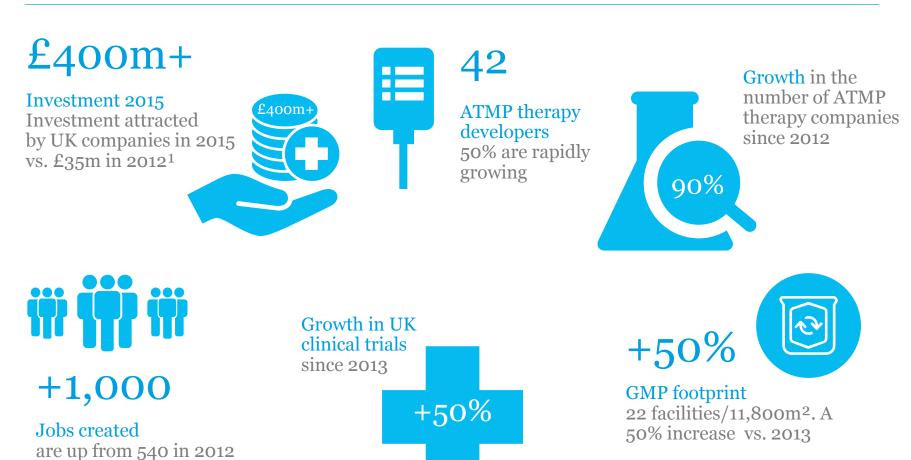
Health economics and market access



Industrialisation



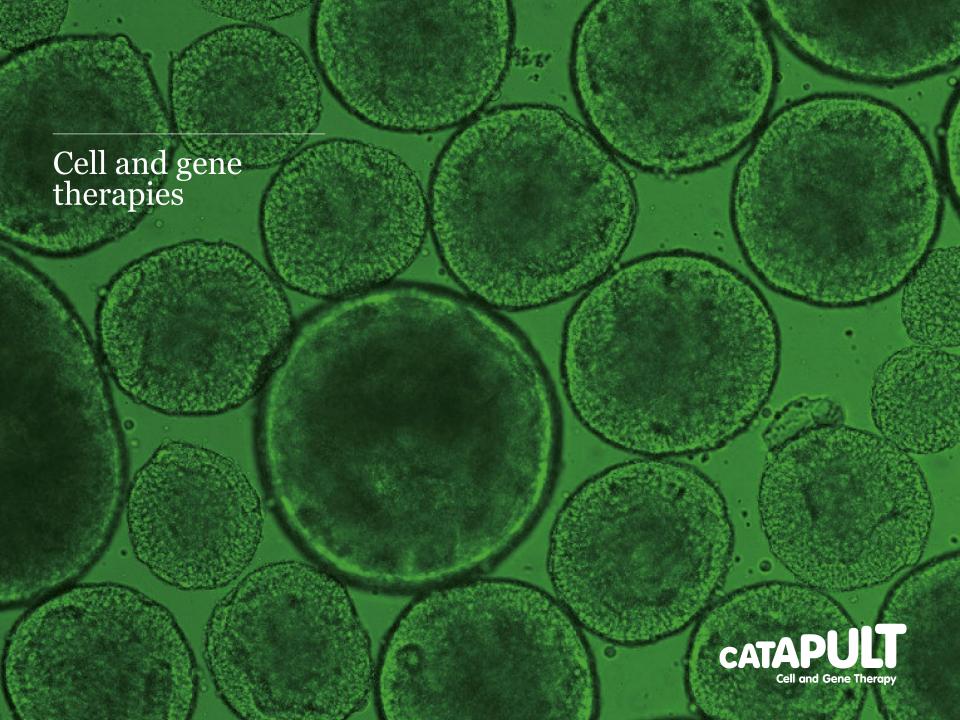
### UK industry growth 2012 to 2015



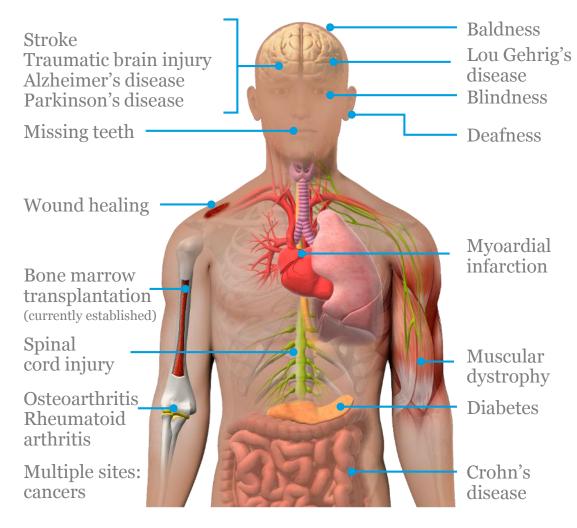
(expected to exceed 2,000 in 5yrs)



<sup>&</sup>lt;sup>1</sup>Excludes Smith & Nephew acquisition of Healthpoint for \$782M in 2012



#### Potential of cell therapies



## Potential cell sources include:

- Pluripotent stem cells
- Adult stem cells e.g. MSCs
- Hematopoietic stem cells
- Immune cells



#### Major milestones and key data events

#### Examples of major milestones and key data events: Q3 2016

- Fate Therapeutics receives FDA Orphan Drug Designation for ProTmune in allogeneic hematopoietic cell transplantation - September 26, 2016
- Kite Pharma announces positive topline KTE-C19 data from ZUMA-1 pivotal trial in patients with aggressive non-Hodgkin lymphoma – September 26, 2016
- Cellular Dynamics International, a FUJIFILM company, announces launch of iCell Hepatoblasts to enable research into therapies that stimulate liver regeneration — September 22, 2016
- bluebird bio's LentiGlobin investigational gene therapy for transfusion-dependent beta-thalassemia is accepted into European Medicines Agency's PRIME Program — September 21, 2016
- Alliqua BioMedical announces commercial introduction of Interfyl Connective Tissue Matrix September 19, 2016
- Asterias Biotherapeutics announces positive efficacy data in patients with complete cervical spinal cord injuries treated with AST-OPC1 — September 14, 2016
- Sangamo BioSciences receives Orphan Drug Designation from U.S. FDA For SB-FIX, first application of therapeutic in vivo genome editing — September 6, 2016
- GenSight Biologics receives Orphan Drug Designation from the European Commission for product candidate GS030 for treatment of retinitis pigmentosa. The EMA also granted Advanced Therapy Medicinal Product classification to GS030 - September 1, 2016
- MolMed S.p.A. receives Conditional Marketing Authorization from the European Commission for Zalmoxis, the first immunogene therapy for adults with high-risk haematological malignancies — August 22, 2016
- iCell Gene Therapeutics announces U.S. FDA has granted Orphan Drug Designation for its chimeric antigen receptor engineered T-cells for the treatment of peripheral T-cell lymphoma — August 11, 2016
- Spark Therapeutics announces new positive data from continuation of Phase 3 trial of voretigene neparvovec, its most advanced product candidate, for treatment of inherited retinal disease — August 10, 2016
- Mesoblast Phase 2 trial results of MPC-300-IV show dose-related improvements in biologic refractory rheumatoid arthritis - August 9, 2016









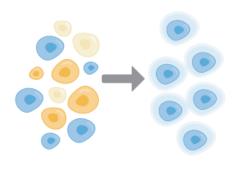


#### Example – T cell therapy

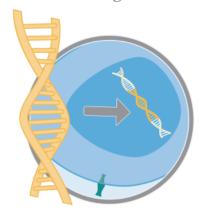
Collect patient's white blood cells



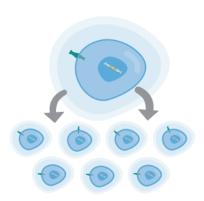
Isolate and activate T cells



Engineer T cells with CAR or TCR gene



Grow and expand number of T cells



Infuse patient with engineered T cells

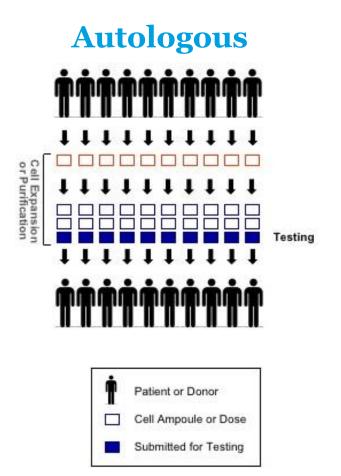


Modified from Kite Pharma



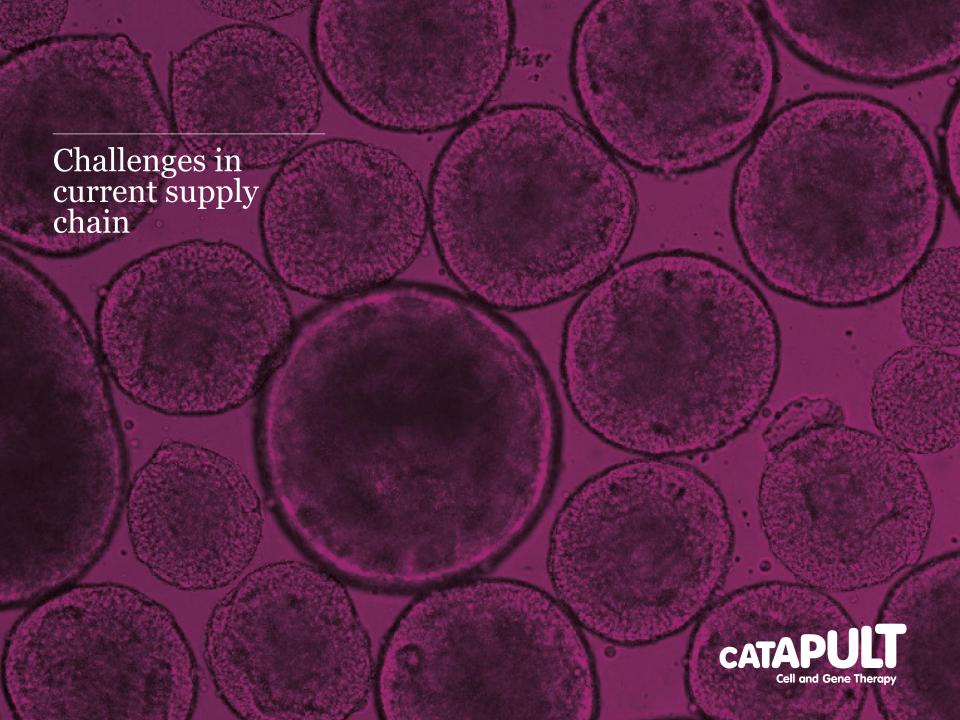
### Terminology and logistics challenge

# Allogeneic Master Cell Bank Working Cell Banks Cell Expansion



Courtesy of Lonza



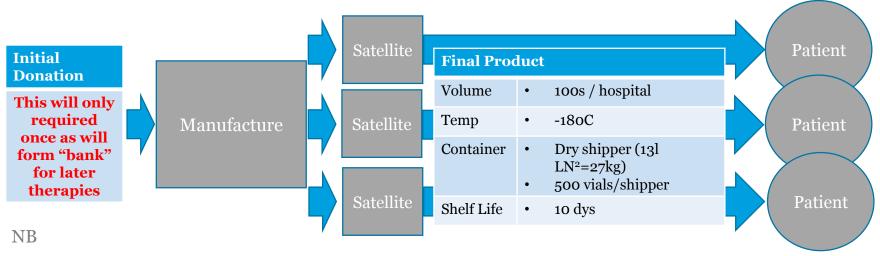


## Low volume - orphan indication (20 patients/yr)

e mar	row	donation					
olume	•	20/yr					
emp	•	Controlled ambient					
ontainer	•	Blood bag			Final p	rodu	ct
Shelf Life	•	<24hrs			Volume	•	20/yr
					Temp	•	2-4C
				Manufacture	Containe	er •	50-80ml in 120ml syringe Shipped in metal box
iral vecto	r		_		Shelf Lif	e •	< 24 hrs
lume	•	"Large" single shipment		NB			
emp	•	-8oC				lying	EU, one US site supplying N
ontainer	•	Vials		Contingency planning is vital.			
Shelf Life	•	Months		<ul><li>No consolidation with other shipments possible.</li><li>Maximum visibility at all points during shipping.</li></ul>			



#### High volume allo therapy (100,0000 patients/yr (globally)

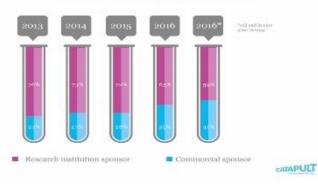


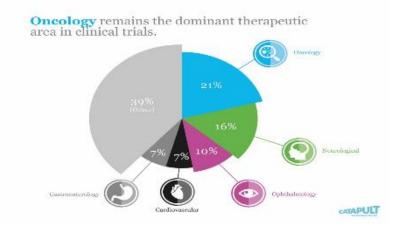
- Large central manufacturing
- Deliveries will be restocking as opposed to patient specific
- Consolidation of final product is essential
- Different product formulations and final packaging may decrease number of doses per shipper significantly.
- Significant space required for dry shippers, insulated boxes, dry ice and LN2 storage

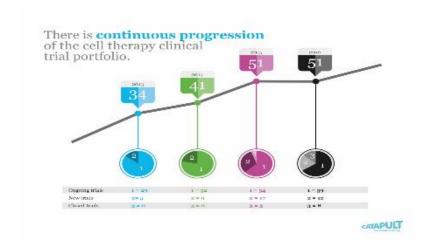


#### Growth = challenge

More cell and gene therapy trials are now being sponsored by commercial organisations.



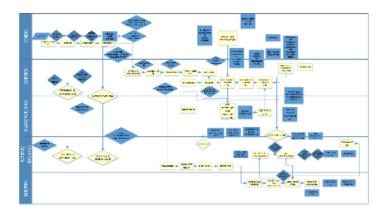




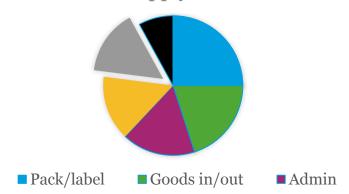


### Hidden challenges

Cell is the product



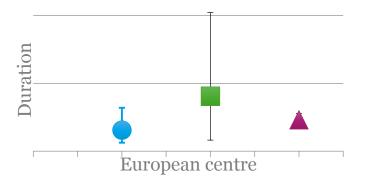
Manual supply chain



Complicated systems

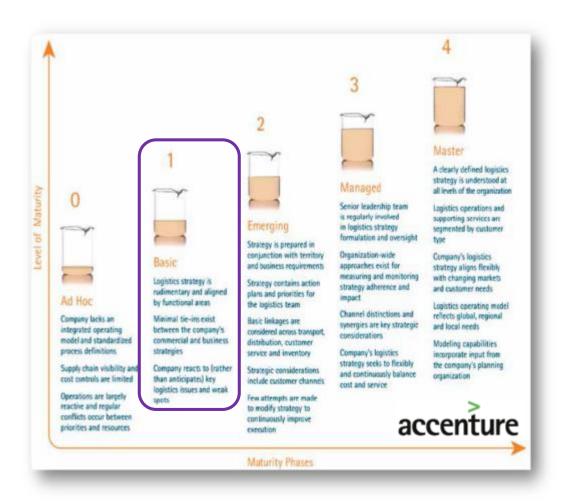


Variable supply chain



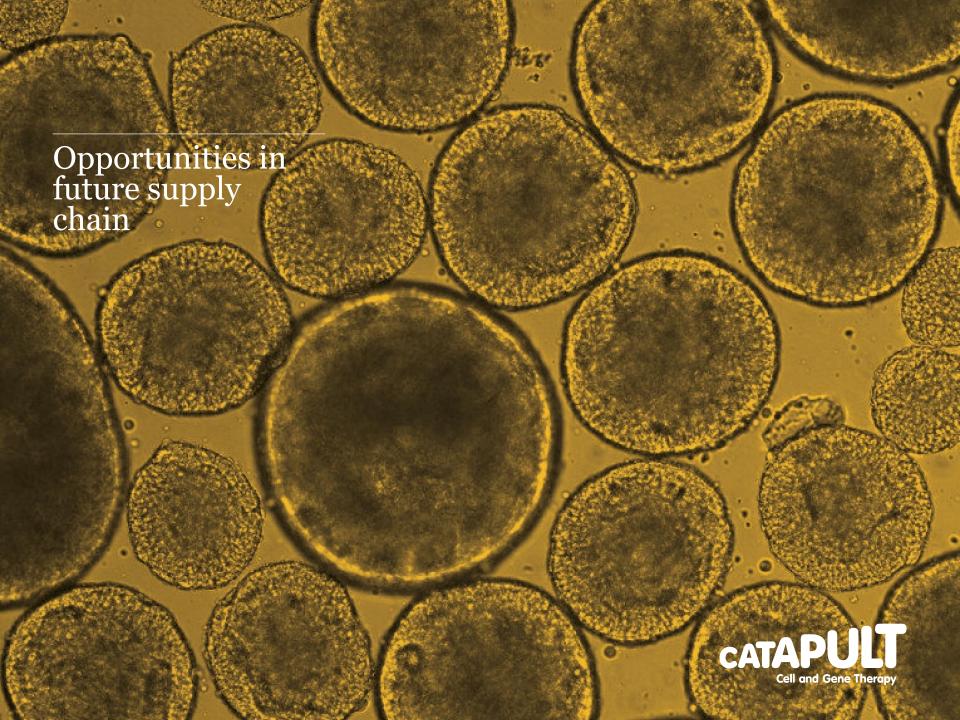


#### Benchmarking

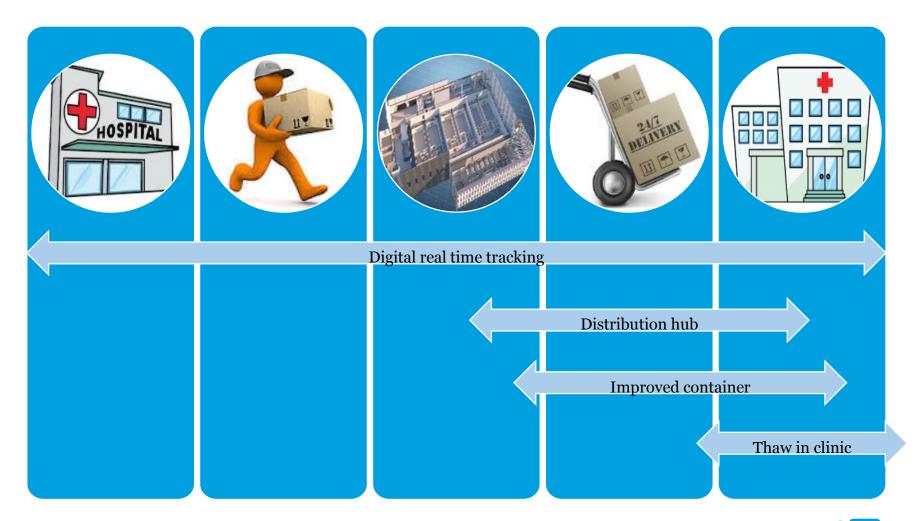


- Limited number of specialist providers
- White glove service
- "No" shipment integration
- Data from clinical trial is critical
- Cost "irrelevant"
- Limited development of shipping technologies





## Updating the supply chain





#### This is not a new challenge



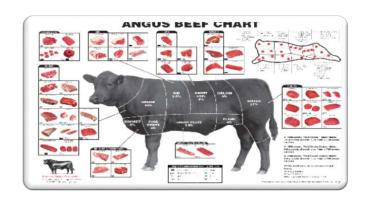
High volume, high value shipping



Validated, track and trace



1.85m cell therapies per year



Cold Supply Chain for "cells"



### Opportunities – working together to.....



...meet patient/clinician needs.



...repurpose existing technology.



...create a viable, supply chain.



...enable a global industry.



# Cell and Gene **Therapy Catapult** 12th Floor Tower Wing Guy's Hospital Great Maze Pond London SE1 9RT +44 (0)20 3728 9500 info@ct.catapult.org.uk ct.catapult.org.uk Twitter: @CTCatapult We work with Innovate UK Introduction Cell and Gene Therapy