PharmaVOICE

THERAPEUTIC DIGEST

THE AGE OF

GENE THERAPY

JANUARY 2020

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The Age of Gene Therapy

Opportunities and Challenges in this Burgeoning Therapeutic Sector

In November 2010, Amy Price's two youngest children were tested for metachromatic leukodystrophy (MLD), a rare and progressive disorder that affects the protective covering around the nerve cell and the nerve fibers. It is a fatal diagnosis. At that time, her daughter was 2 ½ years old and her son was 11 months old.

"We were very lucky to be seen by a doctor who was very knowledgeable about leukodystrophy," Ms. Price says. "This is not a common experience for a lot of families because it is a rare disease and they so often have to go through a diagnostic odyssey." A month later, two days before Christmas, they received the confirming diagnosis. Ms. Price, a community psychologist and researcher by profession, sprung into action. Her research led her to a clinical trial for MLD taking place in Milan, Italy. She emailed the head doctor and was told that because her daughter was already symptomatic, she wasn't eligible for the trial. However, her son was. Three weeks later, they packed up their family and took their four children to Milan to be part of the trial. "In 2011, my son was the second child in the world to undergo gene therapy for MLD." The gene therapy drug used in his clinical trial is OTL-200 and is now in Phase II clinical trials in Milan, Italy. Today, her son is about to turn 10 years old. Her daughter, at 5 ½, passed away in 2013.

More than 800 cell and gene therapies are in development for 100+ diseases.

The age of gene therapy promises a wave of life-changing and life-saving medicines. It provides treatment options for diseases that are beyond the reach of traditional approaches. Today, there are nearly 800 cell and gene therapies under development that would treat more than 100 diseases[1].

In recent years, genome-based medicines have begun to win approval in a growing number of therapy areas. Several RNA- and DNA-based therapies are already available, and the first curative gene therapy approved in 2018, Luxturna, is for the treatment of Leber's congenital amaurosis, an inherited retinal disorder that causes severe visual impairment starting in infancy. The pace of genome-based products reaching the market is accelerating quickly, with the approval of Yescarta (large B Cell lymphoma), Spinraza and Zolgensma (spinal muscular atrophy), and Exondys 51 (Duchenne muscular dystrophy), to name a few.

At least nine gene therapies have been approved for certain types of cancer, some viral infections, and a few inherited disorders. In the most basic terms, these therapies work either by gene insertion or gene interference. Below are some of approved gene therapies around the world.

Gene Insertion

These treatments use a harmless virus to carry a good gene into cells, where the virus inserts itself into the existing genome, cancelling the effects of harmful mutations in another gene:

Gene Therapy	Company	Approval Information
Gendicine	Shenzhen Sibiono GeneTech	China's regulatory agency approved the world's first commercially available gene therapy in 2003 to treat head and neck squamous cell carcinoma. The drug is still waiting FDA approval.
Glybera	Amsterdam Molecular Therapeutics	The first gene therapy to be approved in the European Union (EU) that treats lipoprotein lipase deficiency (LPLD), a rare inherited disorder that can cause severe pancreatitis. Due to limited patient population, the drug was deemed unprofitable and by 2017 its manufacturer declined to renew its marketing authorization. Glybera is no longer on the market.
Imlygic	Amgen	The drug was approved in China, the US, and the EU to treat melanoma in patients who have recurring skin lesions following initial surgery.
Kymriah	Novartis	Developed for patients with B cell lymphoblastic leukemia, a type of cancer that affects white blood cells in children and young adults. It was approved by the FDA in 2017 and the EU in 2018.
Luxturna	Spark Therapeutics	Approved by the FDA in 2017 and in the EU in 2018 to treat patients with a rare form of inherited blindness called biallelic RPE65 mutation-associated retinal dystrophy, which affects 1,000-2,000 patients in the US.
Strimvelis	Orchard Therapeutics	About 15 patients are diagnosed in Europe every year with severe immunodeficiency from a rare inherited condition called adenosine deaminase deficiency (ADA-SCID). It was approved in the EU in 2016.
Yescarta	Kite Pharma/Gilead Sciences	Developed to treat large B cell lymphoma, it was approved by the FDA in 2017 and the EU in 2018. It is in clinical trials in China.
Zolgensma	Novartis	Approved in May 2019, by the FDA for children younger than 2 years with spinal muscular atrophy.
Zynteglo	Bluebird	Granted approval by the EU in May 2019, it treats a rare blood disorder called beta thalassemia, which reduces a patient's ability to produce hemoglobin. The drug is still waiting FDA approval.

Source: Nature Research Journal, December 2019

Gene Interference

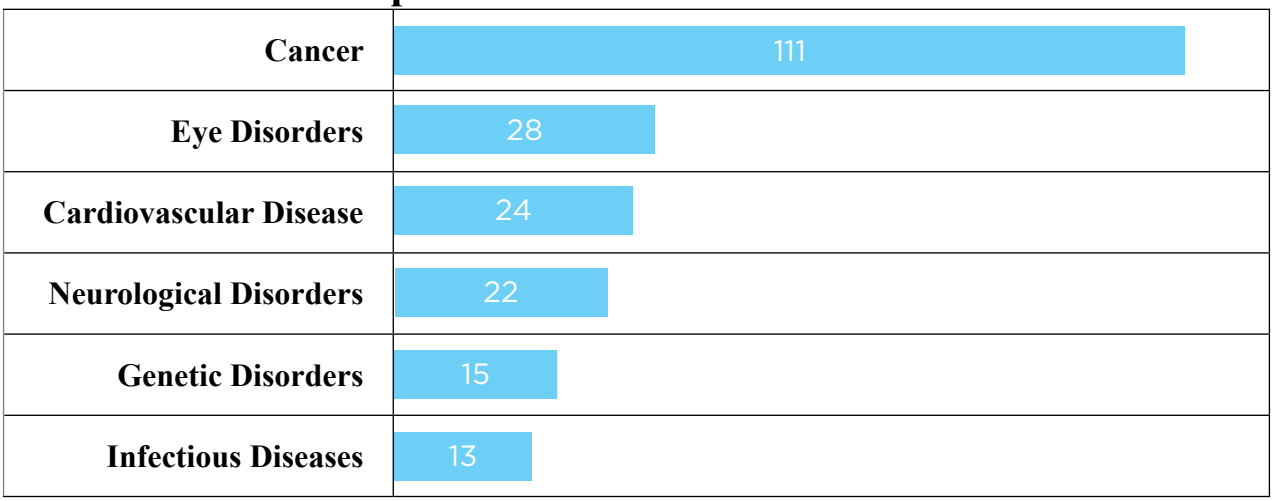
This approach uses a synthetic strand of RNA or DNA (aka: oligonucleotide) that, when introduced into a patient's cell, can attach to a specific gene or its messenger molecules, effectively inactivating them. Some treatments use an antisense method, named for one DNA strand, and others rely on small interfering RNA strands, which stop instruction molecules that go from the gene to the cell's protein factories.

Gene Therapy	Company	Approval Information
Defitelio	Jazz Pharmaceuticals	This drug contains a mixture of single-strand oligonucleotides obtained from the intestinal mucosa of pigs. It was approved with limitations in the US and EU in 2017, treating severe cases of veno-occlusive disease.
Exondys 51	Sarepta Therapeutics	In 2016, the FDA granted approval to Exondys 51, a treatment for a form of Duchenne muscular dystrophy.
Kynamro	Genzyme Corporation	Kynamro received FDA approved in 2013, it was designed to inhibit or shut down the production of a protein that helps produce low-density lipoprotein (LDL).
Kymriah	Novartis	Developed for patients with B cell lymphoblastic leukemia, a type of cancer that affects white blood cells in children and young adults. It was approved by the FDA in 2017 and the EU in 2018.
Macugen	OSI Pharmaceuticals	Approved by the FDA in 2004, this treats age-related macular degeneration, the leading cause of vision loss in people age 60 and older.
Spinraza	Biogen	Approved by the FDA in 2016, Spinraza became the first gene-based therapy for spinal muscular atrophy.

Source: Nature Research Journal, December 2019

These successes were made possible because of better clinical and scientific understanding of safety profiles as well as an improved manufacturing process that met the consistency and quality standards required for clinical scale. "In gene therapy we can clearly see that the eventual successes were built on a rigorous scientific evaluation of the initial failures," says Katherine High, M.D., emeritus professor of pediatrics in the Perelman School of Medicine of University of Pennsylvania, and president and head of research and development for Spark Therapeutics.

Gene and Cell Therapies in Clinical Trials



Source: Pharmaceutical Research and Manufacturers of America

BACK TO BASICS

Before we dive into the various gene therapy modalities, let's take a step back and discuss what gene therapy entails.

The basic principle for gene therapy "is that for people born with serious genetic diseases, if we can provide a normal copy of the gene that contains the mutation to the physiologically relevant target cells, then the patient can make the missing protein for him or herself," Dr. High explains.

To do this, gene therapy is based on two basic strategies:

1. An integrating vector that is introduced into a stem cell so that the gene integrates at one or more places in the patient's chromosomes, also known as ***ex vivo***
2. The gene is delivered in a nonintegrating vector to a long-lived postmitotic[2] or slowly dividing cell, which ensures the expression of that gene for the life of that cell, also known as ***in vivo***

Ex Vivo

For ex vivo transduction, cells are extracted from the patient and transduced with the gene of interest. The cells are then returned to the patient. This approach requires a gene-delivery vehicle (aka vector), the DNA that makes the gene itself, and a technically sophisticated facility for processing cells.

In Vivo

In vivo gene delivery resembles the delivery of other pharmaceutical agents. The vector-gene composition is stored frozen and then is thawed and prepared by a pharmacist and is typically administered in an outpatient procedure.

Gene Therapy Modalities

Antisense Oligonucleotides (ASOs)	Small pieces of DNA or RNA that can bind to specific molecules of RNA. This blocks the ability of the RNA to make a protein or may be used to block production proteins needed for cell growth	In Vivo
Gene Editing	This modality inserts, removes, changes, or replaces specific pieces of a patient's DNA. Scientists explore ways to edit pieces of DNA at precise spots along the gene. CRISPR (or CRISPR-Cas9) technology is a powerful tool for editing genomes. It allows researchers to easily alter DNA sequences and modify gene function.[3] Other tools are Zinc Finger Nuclease and Talen	Ex Vivo & In Vivo
Messenger RNA (mRNA)	Since mRNA carries copies of the information contained in DNA to ribosomes, which in turn assemble proteins, mRNA can be used to induce production of desired protein without having to push genetic material into the genome.	In Vivo
RNA Interference (RNAi)	RNAi is a biological process in which RNA molecules inhibit gene expression or translation, by neutralizing targeted mRNA molecules.	In Vivo
Viral Vector	All viruses attach their hosts and introduce their genetic material into the host cell as part of the replication process. This genetic material contains instructions on how to produce more copies of these viruses. Some types of virus actually physically insert their genes into the hosts' genomes. This incorporates the genes of that virus among the genes of the host cell for the life span of that cell. Viral vectors are created when scientists remove the genes in the virus that cause disease and replace them with genes that encode the desired effect.	Ex Vivo & In Vivo
Other	Other gene therapy modalities include: • Plasmids: the simplest form of vector for transport of DNA into the cell nucleus • Lipoplexes and Polyplexes: are created to improve the delivery of the new DNA into the cell, the DNA must be protected from damage and entry into cell must be facilitated	Ex Vivo & In Vivo

Source: Gene Therapy Net

EVERSANA™

DRIVING THE COMMERCIALIZATION OF REGENERATIVE MEDICINE

Colin Coffua,
Senior Vice President,
Global Strategic Accounts

With more than 7,000 distinct types of rare and genetic diseases and 400+ million individuals suffering from a rare disease, regenerative medicine holds the hope for a cure – transforming healthcare by revolutionizing patient care from conventional treatment models to curative therapy models.

Regenerative medicine, defined by the National Institutes of Health, includes cell and gene therapy, biomaterials, and tissue engineering. With the advancement of new technologies coupled with the creation of new companies offering a wide range of innovative products and treatments, regenerative medicine has become one of the fastest growing fields of research and the promise of commercial success for all patients. So, it's not surprising, with the potential to treat incurable diseases and conditions (for example: cancers, blood disorders, diabetes), that in their Q3 2019 Data Report, The Alliance for Regenerative Medicine shared that there are more than 1,000 ongoing global clinical trials.

This growth is expected to continue over the next 10+ years with the launch of new therapies developed for specific diseases. With this growth, we must be mindful of the impact the time invested in developing these novel therapies has on their commercial success. Commercial effectiveness must be commenced promptly and efficiently to allow for recovering the investment made during development processes. Still, alignment of clinical development and commercialization strategies, demanding more expertise and business modeling, insurance coverage and reimbursement strategies are critical factors to promote the clinical translation of regenerative medicine technologies.

With a fragmented market focused on the clinical and scientific development and technical side of the industry, there is an immediate need for an innovative, end-to-end commercial solution to support these emerging therapies. As the regenerative medicine landscape continues to mature, biopharmaceutical companies will need to make a number of strategic choices to drive success, given commercial challenges that include: fast depletion of addressable populations, complex market access dynamics, and challenging gene therapy franchise sustainability.

> "The continuous progress in regenerative medicine will change the future of healthcare. Manufacturers will need commercial strategies ready for this new healthcare paradigm, well in advance of product launch."

These therapies will change the future of healthcare and manufacturers will need commercial strategies ready for this new paradigm. The question for consideration is how do we successfully commercialize regenerative medicine therapies to ensure all the key stakeholders' needs are properly addressed? With only a handful of approved therapies in the marketplace, we can build a regenerative medicine ecosystem that delivers more value to patients faster by:

Understanding the value of regenerative therapies for patients, physicians, caregivers, healthcare systems and society:

Provide Market Insights, Gene Therapy Market Strategy, Managed Markets and HCP agency services, Patient Engagement and Communication, and Patient Identification and Commercial Recruitment for complex therapies

Sharing the risk of uncertainty to prove the lifelong value of therapies:

Provide Health Economics and Outcomes Research tools and services. Generate data for value that is meaningful to Payers and Government Stakeholders

Making treatments affordable:

Provide Global Pricing and Market Research Tools specific to Gene Therapies, and Innovative Contracting Models and Pay for Performance Expertise

Helping patients realize the value of therapies:

Provide Patient Support Programs and Reimbursement Services, Treatment Coordination, Cold Chain Logistics and Alternative Payment Models

Addressing pricing and reimbursement for regenerative therapies:

Provide Real-time Market Research, Government and Payer Pricing Consulting and Management. Generate data that is meaningful for all Payer and Government Stakeholders

The path forward in leading the product lifecycle for regenerative medicine – from clinical trial recruitment through commercialization – includes the process and infrastructure needed to accelerate effective launch planning to in-market success. Key to this dynamic are strategic alliances that provide commercial solutions directed at educating and supporting patients, providers, payers, and pharmaceutical companies.

EVERSANA's partnership with CRYOPORT, the global leader in providing temperature-controlled logistics solutions for life sciences commodities, provides unmatched clinical and commercial solutions. Our global solutions platform delivers everything from pricing and market access strategies to cold chain channel management, patient services and speciality pharmacy. With the strength of our strategic alliances, EVERSANA has taken the lead in building an integrated ecosystem providing the most cost effective and dynamic clinical and commercial solutions supporting regenerative medicine. Let's make the promise of regenerative medicine a reality for the millions of patients who deserve it.

About EVERSANA™

EVERSANA is the leading independent provider of global services to the life science industry. The company's integrated solutions are rooted in the patient experience and span all stages of the product lifecycle to deliver long-term, sustainable value for patients, prescribers, channel partners and payers. The company serves more than 500 organizations, including innovative start-ups and established pharmaceutical companies to advance life science solutions for a healthier world. To learn more about EVERSANA, visit EVERSANA.COM or connect through LinkedIn and Twitter.

HISTORY AND OVERVIEW OF THE MARKET

The hundreds of new gene therapies in the pipeline could transform care across multiple therapeutic areas. It has taken a few decades of advances and reversals to get to the point where we are now.

Gene therapy research first began to emerge in public understanding in the 1990s. However, the promise of gene therapy came to a standstill upon the death of a teenage patient named Jesse Gelsinger in 1999 when he had an immune reaction to the vector transporting a gene therapy for his metabolic disorder. It took nearly two decades before better clinical and scientific understanding of the safety risks facilitated the first wave of clinical success.

10 to 20 cell and gene therapy approvals expected per year by 2025.

Fast-forward nearly 20 years. In 2018, more than 150 investigational new drug applications were filed for gene therapy alone. Analysts expect this market to grow significantly, with 10 to 20 cell and gene therapy approvals per year predicted for the next five years[4]. This growth is set to come from a wide range of modalities from ASOs and RNAi. Clustered regularly interspaced short palindromic repeats (CRISPR) gene editing-based therapies present a long-term growth opportunity, which generated a significant excitement and investment in technology, with more than $600 million invested in CRISPR start-ups in 2017[5] and the first in human trials kicked off in 2019. However, they are not likely to have a significant clinical impact before 2025.

The gene therapy market is going to expand across different modalities and therapeutic areas. On the following page is a table that indicates addressable global population for each therapeutic need and mode of therapy.

● 1000 ● 10,000 ● 100,000 ● 1,000,000 ★Approved Therapies

Modalities

Therapeutic Area	Disorder	ASO[1]	mRNA[2]	mRNA[2] RNAi[3]	Viral Vector	Gene Editing[4]	Other[5]
Hematological	Hemophilia (A+B)			●	●		
	Beta thalassemia				●	●	
	Sickle cell disease				★●	●	
Ophthalmic	RPE65-mutation associated retinal dystrophy				★●		
	Choroideremia				●		
	Achromatopsia				●		
	X-linked retinitis pigmentosa				●		●
Musculo-Skeletal	X-linked myotubular myopathy				●		
	Duchenne muscular disorder	★●			●		
Neurological	Spinal muscular atrophy	★●			★●		
	Huntington's disease	●			●		
Metabolic	Familial hyper-cholestrolemia			●			
	Hereditary ATTR amyloidosis	★●		★●			
	Hereditary hyperlipidemias	●					
Hepatological	Acute Porphyria			●			
Infectious	Broad		●				
Oncological	Late-stage ovarian cancer						●
	Breast cancer and glioblastoma					●	

[1]Antisense Oligonucleotide [2]Messenger RNA [3]RNA Interference [4]Eg: CRISPR, ZFN [5]Eg: Plasmids

Source: American Society of Gene and Cell Therapy

As of 2019, the majority of the focus in development has been on monogenic rare disease, which is when a single gene is implicated in the disease process. Because rare diseases tend to have clear genomic targets as well as high unmet need in small patient populations, this has enabled a faster approval process by regulatory authorities.

Most gene therapies come to market under an accelerated regulatory review pathway.

Most of the gene therapies have come to market under an accelerated regulatory review pathway. "That is because gene therapies have received a breakthrough designation by the FDA," says Wayne Pines, senior director of healthcare at APCO Worldwide. "It has to do with the fact that a gene therapy trial has so few patients. You can gather information and collate it more quickly, which makes the difference." It also means that the FDA allows consolidation of the typical Phase I, II, III processes into Phase I, Phase II/III, and confirmatory Phase III after approval, which is a similar trend in oncology research. Additionally, small patient populations make it possible for companies to experiment with innovative trial designs, overseen and with the approval of the FDA.

CURRENT CHALLENGES OF MARKETED DRUGS

Although the first-to-market gene therapies have been approved and offer significant clinical benefit, they have significant new challenges that require rethinking the drug development and go-to-market strategies by key stakeholders.

There are five general areas of challenges for gene therapy.

	DESCRIPTION	CHALLENGES
Market access	Therapies are costly and health systems, especially in the US, are not set up for one-time large payments	Requires significant changes to the healthcare ecosystem with multiple stakeholders involved
Clinical development	Long-term safety and efficacy have yet to be established	While a common issue in new modalities, it requires time and further research to ensure long-term safety and efficacy
Provider and hospital economic disruption	One-time therapies disrupt current healthcare economics (buy-and-bill)	Can be alleviated by insurers offering new setups for making cost of gene therapies more manageable for employers, but challenging to implement more broadly
Manufacturing	Cost of goods sold remain high partially due to low and variable yields, with limited manufacturing capacity	Significant investment is required to expand capacity
Customer journey	Finding patients is challenging, especially for rare diseases that were previously untreatable	This is expected to expand beyond rare diseases

Market Access

The median time workers stay with an employer is 4.2 years.

The U.S. healthcare system is not set up to handle large, one-time payments that may be cost-effective over the long term. Roughly half of Americans get health insurance from their employers, but according to the Labor Department, the median time workers stay with an employer is 4.2 years. If the insurance company expects to cover the patient for a lifetime, or even a minimum of 10 years, that decision would be fairly simple. If it expects to cover a patient for only four years, however, the calculus changes. The thinking goes "Why should I pay today so my competitor or Medicare can receive the long-run benefits?" Other concerns, such as the novelty of gene therapy, add to the risk an insurer faces.

Without long-term data to support the efficacy of these drugs, who pays?

Without long-term data to support the efficacy of these drugs, who foots the next bill if the gene therapy stops being effective after a decade or so? According to an interview by Robert Dubois, M.D., Ph.D., chief medical officer of the National Pharmaceutical Council, in the *Wall Street Journal*, one potential solution to the problem created by patients switching insurers could be forming a new shared risk pool of patients on gene therapy, which minimizes the insurer's incentive to take a short-term view on cost[6].

Pharmaceutical companies are working on solutions as well. To ease the financial burden, Novartis is offering to receive payments in installments. Spark has offered rebates to health plans if the drug fails to do what it promises over the long term. Spark has already submitted a proposal to the Centers of Medicare and Medicaid Services that would allow for installment payments. Those efforts have led to some modest success.

"We only get paid if our therapy works, with annual payments capped at five years versus continued lifelong treatment and cost," says Bluebird CEO Nick Leschly in a statement on the EU approval of the company's gene therapy, Zynteglo, which is priced at $1.8 million, making it the second-most expensive drug in the world. Innovative therapies require innovative solutions for access. However, legal and regulatory reforms to enable multiyear payment models may be required for these therapies to become broadly accessible.

Insurance reimbursement becomes problematic when insurance companies have the choice of either a one-time therapy at a high cost versus a more frequent therapy at a still high, but significantly lower cost. For example, Novartis's Zolgensma is priced at $2.1 million as a curative solution, while the competing drug, Spinraza, manufactured by Biogen costs $750,000 for the first year and then $375,000 for each year after that. This results in insurers placing restrictions on their coverage policies for Zolgensma based on age or severity of disease.

"There are different proposals around value-based type payments: pay-as-you-go or annuity type models to help spread the cost," says Joshua Schimmer, M.D., senior managing director on Evercore ISI's biotech team. "If this is the case, then there's not much difference between the traditional orphan drug model and the existing gene therapy model. At some point these costs may become high enough that even the orphan model is a strain for payers and in that case the system will have to evolve again and again to figure out how to accommodate these medicines and make them affordable." But drugs like Spark's Luxturna, which have been approved to treat

only a small number of patients, won't seriously stress the healthcare ecosystem. Dr. Dubois notes that the system would only change if a therapy aimed at a larger patient population such as Type I diabetes or sickle-cell anemia, were to reach the market, which could lead to billions in payments in just a few years, stressing insurers, Medicare, and Medicaid.

Still, there's some progress in finding a common ground between payers and pharmaceutical manufacturers. "Some of the payers in the United States have done some terrific work in the gene therapy model, for example, ExpressScripts has taken a leadership position along with other large payers to create a framework that encompasses everyone, including patients and innovators," Dr. Schimmer says. "So, we don't have all the answers yet but compared with five years ago, there's been a lot of progress."

Clinical Development

With gene therapies, every patient receives the medication.

Since gene therapies for rare diseases usually involve tiny patient populations, manufacturers can create innovative approaches to clinical trials. However, these innovative pathways may lead to unresolved clinical questions, which are less likely to occur with standard randomized controlled trials. "For most drugs, there are randomized controlled trials, which means half the patients take the drug and the other half take a placebo," explains APCO's Mr. Pines. "With gene therapies, every patient receives the medication because the company is basing its decisions on the fact that there will be an open label," he continues. Regulatory agencies must think differently about how to evaluate gene therapies.

In the past five years there has been an explosion of clinical learnings that has driven gene therapy into the realm of market approved pharmaceuticals. "But there's still a lot of things we don't know," Evercore's Dr. Schimmer says. "Whether its durability or treatment effect and if and when safety issues will evolve. We've seen this knock off a couple of programs," he continues. "There are so many competitive programs, sometimes targeting the same disease. At the same time that the chaos is being amplified, there is also order. We are learning a lot about the clinical profile of these products and where they fit in the treatment armamentarium and where their potential limitations may be."

Clinical development also means significant investment in data collection beyond launch, which includes patient registries, confirmatory trials, and innovative use of real-world data to monitor safety and efficacy over extended periods of time, in addition to continuing to build the value story. This long-term follow-up is essential to ensure the durability of response or long-term safety.

Provider and Hospital Economic Disruption

In addition to the disruption in payer economics, gene therapy also disrupts provider economics. Many of the current treatments that gene therapies could replace, such as blood transfusions for hemophilia, are "buy and bill," which provides substantial long-term revenue for providers and hospitals. Single high-priced dose such as gene therapy through a buy-and-bill process presents risk to the hospital and distribution system. This is because it requires significant negotiations or potentially even a new approach to the traditional pharmaceutical distribution system.

One solution for this may be the establishment of centers of excellence within the gene therapy space. "These centers of excellence can help navigate this complex field," Dr. Schimmer says. "These centers help control the delivery of these products and simplify the model for payers to know that the patients being considered for treatment are seen by someone who is a specialist and help simplify reimbursement."

Manufacturing

Viral vectors address the largest global population.

Certain modalities, viral vectors in particular, still suffer from capacity constraints, high cost of goods, long lead times, and significant upfront investment requirement. Viral vector manufacturing, which is the modality used in most therapy areas explored in gene therapy, is expensive due to low yields (about 10 doses per batch) because of low transfection efficiency, use of adherent cells limiting volume, and packaging efficiency. This results in an average of only 1:100,000 clinically useful viral particles.

"There are all sorts of efforts evolving simultaneously to address capacity," Dr. Schimmer says. "There are brute force efforts to take the systems in place and scale them up for commercial stage. There are also more active efforts in biomanufacturing, including suspension cell systems, and scaling those up for commercial stage." At this point, the number of FDA-approved products is quite small. However, according to Dr. High, most of what's needed for the use of AAV vectors,

which are administered directly to the patient, is already in place in the current medical care system. "Cold chain supply for vectors that are stored at -80^{O} is already in place for a number of specialty pharmaceutical products," she says. Cell therapies that involve the transduction of the patient's hematopoietic stem cells, which after manipulation of the cells in the lab need to be returned to the patient, will need a technically sophisticated cell-processing facility with highly trained personnel to manage the process.

Customer Journey

Amy Price, the mother of two MLD diagnosed children mentioned at the beginning of this article, became a rare disease advocate. According to Ms. Price, some therapies are only available at a limited number of facilities, requiring patients to travel for diagnosis, treatment, and follow-up. This leads to the "biggest challenges with gene therapy," she says. Even when a patient qualifies for a clinical trial or treatment, the fiscal burden for travel and follow-ups are financially draining. GoFundMe, patient advocacy organizations, and non-profit organizations such as the National Organization for Rare Disorders (NORD) help alleviate some of that burden. Speaking from her own experience as her son underwent gene therapy treatment in 2011, "as time has gone on, they have added a psychologist to the staff. There's an awareness that there are different needs that need to be met for the families and the children."

A continuum of care is needed from the trial site to when families return home.

According to Ms. Price's conversation with other families undergoing gene therapy, what is needed is a continuum of care from the trial site to when families return home. "When you leave the trial site and that clinical trial experience, you go back home and you're suddenly back in a normal environment," she says. "And you're supposed to go on with your normal life but you're a completely changed person."

Because early gene therapies have been focused on rare diseases, finding eligible patients who have been diagnosed is difficult. For example, fewer than 30% of hereditary transthyretin amyloidosis (hATTR) patients, a rare condition that has a prevalence of 30,000 to 50,000 people worldwide, have been diagnosed. Gene therapy treatments for hATTR are Onpattro and Tegsedi, which were approved within months of each other. This leads to an intense competition for a limited patient pool to treat[7].

CONCLUSION

Thanks to clinical, manufacturing, and technological advancements, we are starting to realize the promise of gene therapy. But there are significant hurdles still to overcome. Strong and continued collaborative efforts across all the stakeholders will be required to surmount the challenges presented by this new class of medicines and to realize their full therapeutic potential[8]. The companies developing these life-changing therapies will have an important role in working with the complex network of stakeholders: empowering the necessary changes and, ultimately, ensuring that their scientific advances are reaching those in need.

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THERAPEUTIC DIGESTS

2020 THERAPEUTIC TOPICS:

Gene Therapy

Mental Health

Neurodegenerative Diseases

Medical Cannabis

Diabetes/Metabolic

Infectious Diseases

Oncology

Cardiology

Digital Therapeutics

Women's Health

Central Nervous System

Rare Disease