



GENE THERAPY APPROVALS & QPS MILESTONES

KEY

QPS

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2003

Oligo PK via LC-MS/MS

● **2006**CLIA Assay - Inclusion/
Exclusion Criteria
Biomarkers - Primary End-point● **2007**

Oligo PK via hybridization-ELISA

● **1998**Gene Interference via ASO
Vitravene/fomivirsen● **2004**Gene Interference via Aptamer
Macugen®/pegaptanib

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2009Oligo PK via hybridization-LC-FLD
Oligo PK via LC-UV**2010**Oligo Biodistribution via Autoradiography
Oligo in vitro Metabolic Stability**2012**Oligo Biodistribution via Microautoradiography
Oligo Metabolite Identification
Oligo ADA
Oligo in vitro CYP Induction

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2011Oligo Biodistribution via QWBA
Oligo Mass Balance/Excretion
mRNA PK/
Biodistribution/
Shedding via QPCR**2012**

Oligo in vitro Reaction Phenotyping

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2014Oligo PK via LC-HRMS
Oligo in vitro Protein Binding
mRNA PK/
Biodistribution/
Shedding via QPCR**2015**Vector PK/
Biodistribution/
Shedding via QPCR
mRNA ADA
Vector ADA
Oligo in vitro Drug Transport

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2016

ddPCR

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GENE THERAPY

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2022

ddPCR

BIOANALYSIS

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ADME

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GENE THERAPY APPROVALS

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- 1998 Gene Interference via ASO Vitravene/fomivirsen
- 2004 Gene Interference via Aptamer Macugen®/pegaptanib
- 2009 Oligo PK via hybridization-LC-FLD
Oligo PK via LC-UV
- 2010 Oligo Biodistribution via Autoradiography
Oligo in vitro Metabolic Stability
- 2011 Oligo Biodistribution via QWBA
Oligo Mass Balance/Excretion
- 2012 Oligo Biodistribution via Microautoradiography
Oligo Metabolite Identification
Oligo ADA
Oligo in vitro CYP Induction
- 2012 In vivo Gene Insertion via AAV1 Glybera/alipogene tiparvovec
- 2013 Gene Interference via ASO Kynamro®/ mipomersen
- 2013 In vivo Gene Insertion via HSV-1 Imlvyic®/talimogene laherparepvec
- 2015 In vivo Gene Insertion via CAR-T Yescarta®/axicabtagene ciloleucel
- 2015 Gene Interference via ASO Spinraza®/nusinersen
- 2016 Gene Interference via polydisperse natural oligonucleotides Defitelio®/defibrotide
- 2016 Ex vivo Gene Insertion via CAR-T Kymriah®/ tisagenlecleucel
- 2016 Gene Interference via ASO Exondys 51®/eteplirsen
- 2016 Ex vivo Gene Insertion via Gammaretrovirus Strimvelis®/autologous CD34+ enriched cell fraction
- 2017 Ex vivo Gene Insertion via LVV Zynteglo®/betibeglogene autotemcel
- 2017 In vivo Gene Insertion via AAV2 Luxturna®/voretigene neparvovec
- 2018 Gene Interference via siRNA Onpattro®/patisiran
- 2018 Gene Interference via ASO Tegsedi®/inotersen
- 2019 Gene Interference via siRNA Givlaari®/givosiran
- 2019 Gene Interference via ASO Waylivra®/ volanesorsen
- 2019 In vivo Gene Insertion via AAV9 Zolgensma®/ onasemnogene abeparvovec-xioi
- 2020 Gene Interference via ASO Viltepso®/viltolarsen
- 2020 Gene Interference via siRNA Oxlumo™/lumisiran
- 2020 Ex vivo Gene Insertion via CAR-T Tecartus™/ brexucabtagene autoleucel
- 2021 Gene Interference via ASO Amondys 45™/ Casimersen
- 2021 Gene Interference via siRNA Leqvio®/inclisiran