Drug Candidates

GEMSEKI

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
06/02/21	GEM245	Recombinant protein based on complement inhibitor C4BP with anti-inflammatory and tolerogenic action	Autoimmune diseases including SLE, IBD and RA	s.c. injection	Protein	Immunology/Inflammation Rheumatology Gastroenterology Renal Disease	Preclinical (before GLP)	・Recombinant protein based on endogenous complement inhibitor C4BP exerts anti-inflammatory and tolerogenic action on dendritic cells. ・A novel biologic for immunomodulation, not immunosuppression. ・Reduces TLR-induced overproduction of proinflammatory cytokines (IL-12, TNF-alpha, IFN-gamma). ・Confirmed in vivo efficacy in SLE model, RA model, and DSS-induced colitis model. ・Global IP coverage (incl. compositions)
05/24/21	GEM244	Recombinant human CC10 protein - multiple mechanisms, replacement therapy	Chronic rhinosinusitis* Acute lung injuries**, including Severe acute respiratory infection, Smoke inhalation, ARDS, COPD exacerbation, and Chronic Lung Diseases**, including Bronchiolitis obliterans, Asthma, and COPD	Intranasal, Intravenous and Inhaled	Protein	Immunology/Inflammation Infection Rare disease Respiratory	*Phase 2 (Phase 1 completed) **Phase 1 (Preclinical completed)	GEM244 is a recombinant version of a naturally occurring secretoglobin protein and an unique, clinical-stage, first-in-class biologic for host defense, ARDS, shock, thrombosis, chronic lung diseases, and transplant. - Proof of pharmacology demonstrated in human infants and numerous animal models, for example anti-inflammatory, anti-fibrotic, and disease-modifying activity, allergy, asthma, COPD, lung repair, transplant, burns, shock, and pulmonary edema/pneumonia - Broad spectrum use in respiratory infection such as Influenza, COVID-19, RSV, possibly bacterial pneumonia - Genetic alleles correlate with deficiencies of the native secretoglobin to identify patients most likely to benefit from this therapy as a replacement of the native protein.
04/30/21	GEM243	Known and available under CDA	Mucositis Prevention and Treatment, Fibrotic Disease Treatment	Injectable or Oral	Small molecule	Immunology/InflammationMetabolic disease Respiratory	Phase 2	Small molecule drug for the prevention and treatment of chemotherapy and radiation therapy induced mucositis. Also shows activity intreating fibrotic diseases such as pulmonary fibrosis and NASH. GEM243 has successfully completed POC human clinical studies in head and neck cancer patients for chemotherapy-induced mucositis prevention with excellent results. GEM243 has shown to be extremely safe and highly effective in P1a, P1b, and P2a human clinical studies. Potentially useful in preventing and treating chemotherapy-induced pulmonary fibrosis and as a direct treatment for diseases such as Covid-19-induced pulmonary fibrosis, idiopathic pulmonary fibrosis, and NASH.
04/28/21	GEM242	Anti-Globo H x CD3 bispecific antibody	Breast cancer	i.v.	Antibody	Oncology: Solid cancer	Discovery	GEM242 has high correct pairing property (>95%) It also possesses target cell-dependent T cell activation property. Anti-cancer efficacy has been demonstrated in the breast cancer animal model through T cell-mediated cytotoxicity. (>83%, 10mg/kg)
04/02/21	GEM241	Analyzer of EEG algorithm by AI	Prediction of seizures in epilepsy patients	Ear wearable	Medical device	CNS	On Market	・A personalized ear-wearable non-invasive small medical device which detects changes in EEG pattern by AI algorithm that alerts seizure minimum one minute before it occurs to patients and caregivers. ・It records brain activities through the ear canal and uses Big Data. ・By predicting the seizure before it occurs, the device will prevent accidents and reduce injuries, emergencies, and deaths. ・It reduces emotional impact such as anxiety/depression and increases de quality of life. ・Big Data treatment can help doctors and medical society to better understand the illness and perform patinets' follow-up.
03/24/21	GEM240	Genetically modified adipocytes	genetic diseases and intractable diseases	Transplant	Gene and Cell therapy	Rare disease	Phase 1	Genetically modified adipocytes for gene therapy and regenerative therapy. It is developed for the treatment of various genetic disease and metabolic disorders. It shows sustainable and stable efficacy or secretion of transduced gene products from implant of GEM240. GEM240 is incomparable and patient-friendly.

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02/26/21	GEM-CVD08	An anti-SARS-COV-2 S1 RBD antibody	COVID-19	i.v.	Protein	Infection	Phase-1	> 10 fold higher binding affinity and >50 fold more potent blocking potency than soluble hACE2-Fc. Neutralize authentic SARS-COV-2 virus infection of Vero E2 cells at IC50 = 0.012 - 0.062 μg/ml. Showed binding and blocking activity against South Africa and UK mutants. Engineered Fc to reduce potential ADE risk. Obtained CHO-K1 CMC clone with high expression titer
01/13/21	GEM239	Activation of Treg and downregulating pro-inflammatory cytokines	Psoriasis, Psoriatic arthritis, Rheumatoid arthritis, Ankylosing spondylitis, Crohn's and colitis	Oral	Small molecule	Immunology/Inflammation Dermatology Orthopedic	Human POC completed	Microbiomes are important for regulating human immune systems.GEM239 is a small molecule known as a gut microbial metabolite. It downregulates pro-inflammatory cytokines, and promotes differentiation of anti-inflammatory Treg cells. Human POC study in small number of psoriasis patients has been done and significant treatment effects have been seen. FDA IND approved. Clinical trial starting in 30 patients. Formulation-science has been applied.
01/06/21	GEM238	CSN5 inhibitor	Cancer	i.v.	Peptide	Oncology: Solid cancer Oncology: Hematological cancer	Preclinical	- Identifying CDK2 binding regions within the CSN5 protein - Specifically inhibits the binding between CSN5 and CDK2 in "small complex" that is specifically expressed in cancer cells. - It is possible to specifically inhibit the growth of cancer cells while suppressing the effect on normal cells.
01/04/21	GEM237	Autologous chondrocyte cell therapy for cartilage repair/regeneration	Chondral and osteochondral articular lesions of the knee	Arthroscopic implantation	Cell and scaffold	Regenerative medicine Orthopedics	Launch	The autologous cartilage repair system (a device kit consisting of a bioabsorbable highly porous scaffold and an enzyme for processing removed a small amount of cartilage) is for one-step surgery. It does not require an *ex vivo* cell expansion process. Hyaline cartilage is regenerated and long-term effectiveness is superior to the marrow stimulation procedure.
12/25/20	GEM236	Nicotinamide phosphoribosyltransferase (NAMPT) inhibitor	Hematological (AML, ALL, lymphoma, MM) and some solid tumors (sarcoma, kidney, melanoma. etc)	Oral	Small molecule	Oncology: Hematological cancer Oncology: Solid cancer	Phase I/IIa	-NAMPT is critical for the growth/survival of hematological cancers. -Synthetic small molecule structurally unrelated to NAMPT substrate or known inhibitors. -will be the First-In-Class drug. -Favorable pharmacological and toxicological profiles, showed no ophthalmic toxicity. -May increase susceptibility to other targeted cancer drugs (BCL-2, PARP, tyrosine kinase, proteasome, and HDAC inhibitors, anti-PD-1 antibodies) and DNA-damaging chemo/radiotherapy. Synergizes with tumor-specific mutations (IDH1/2, PPM1D, DNA repair deficiency). -Phase I study, which is near completion, demonstrated favorable toxicology profile with myeloid cells dose-limiting toxicity and signs of efficacy seen in several patients.
12/25/20	GEM235	Mineral sunscreen powder	Sunscreen	Topical	Natural ingredient	Dermatosis	Commecial	GEM235 is an easy-to-use brush applicator, filled with an effective mineral powder with SPF 50. The 100% natural formula makes GEM235 safe to use on rash-prone skin, eczema, allergy-prone skin and sensitive skin.
12/21/20	GEM234	Crosstalk of TGF-β signal and Wnt/β-catenin signal	Liver fibrosis, Nonalcoholic steatohepatitis, Kidney fibrosis, Renal fibrosis, Liver cancer, COVID-19	Injection	Small molecule	Infection Metabolic disease Oncology: Solid cancer Respiratory Renal disease	Preclinical	GEM234 is a novel small molecular which has suppressive effects on both hepatic stellate cell activation and kidney and liver fibrosis by suppressing TGF-β/Smad pathway via inhibition effect of Wnt/β-catenin pathway. GEM234 shows a higher suppressive effect on liver cancer stem cells than 5-FU. Wnt/β catenin inhibitors can block the infection of SARS-Cov-2, and GEM234 has potential to prevent occurrence of ARDS and cardiovascular damage in COVID-19.

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12/04/20	GEM233	Inhibition of pro-cytokines, enhancement of growth factor PDGF	Diabetic foot and leg ulcers	Topical	Botanical	Dermatosis Metabolic disease	Phase-2 Completed	Small molecules from soybean extract. MOA facilitates multiple phases at molecular levels of wound healing processes. Effective in STZ induced diabetic wound model and cell migration quality control. In Phase 2 study, ulcer complete closure rate up to 12 weeks is 32.7% in GEM233 group vs 15.4% in placebo group. Subjects in the GEM233 group had an average of 73±2.9 days to achieve ≥ 90% reduction in target ulcer size.
11/27/20	GEM232	Anti-soluble MICA/MICB antibody	Prostate Cancers (mCRPC), other cancers	i.v.	Antibody	Oncology: Solid cancer	Preclinical	- GEM232 is a humanized antibody specific for soluble NKG2D ligands MICA and MICB, which are multi-mechanistic suppressors of the immune system that become upregulated in cancer but are normally absent. - GEM232 binds non-membrane bound MICA/B I3(shed/soluble forms) but not cell surface attached versions, thereby offering safety benefits such as avoiding autoimmunity. - Antibody binding may help prevent immunosuppression and may enhance NK and CD8+ T cell activation mediated by the NKG2D receptor leading to tumor cell killing. Both arms of immune system (innate and adaptive) can be impacted. - Significant tumor inhibition demonstrated using prostate xenografts in both immune compromised mice and in mice with humanized immune systems (hPBMC), with no observable toxicity. A unique epitope has been identified for this high affinity antibody.
11/25/20	GEM231	JNK inhibitor	Dry Eye, Dry and Wet AMD, Uveitis, Chronic inflammation alternative to Steroids	Intravitreal, Subconjunctival, Drops	Peptide	Ophthalmology	Clinical Phase 3 (performed in acute post surgery)	・Potent and selective non-ATP competitive hJNK2 and hJNK3 inhibitor ・Full D amino acids – TAT peptide with high resistance to proteases and highly soluble in saline ・Coupled to a carrier sequence that selectively delivers it into the cell ・Excellent safety and toxicology profile (therapeutic indexes in 100 -1000 range) ・Administered to 1000+ patients to date with no sign of intolerance ・Excellent patent position ・Simple to manufacture at low COG per dose
11/25/20	GEM230	Anti-CD38 scFv-Fc conjugation of lenalidomide	Multiple Myeloma	i.v.	Antibody-drug conjugates	Oncology: Solid cancer	Preclinical	GEM230 - The conjugation does not affect cell binding affinity compared to parental antibodies. - Conjugation with lenalidomide bundle did not affect ADCC/CDC activities on CD38+ cells - In the multiple myeloma xenograft mouse model, GEM230 has superior tumor suppression ability compared to parental antibody, Darzalex.
11/25/20	GEM229	Insulin with fatty acids bundle	Type1/2 Diabetes	s.c.	Peptide conjugated fatty acid	Metabolic Disease	Preclinical	GEM229 - can be produced in high quality and activate AKT phosphorylation as degludec. - can induce cell proliferation as degludec and inhibit cell apoptosis as degludec. -can better reduce blood glucose than degludec and effectively control blood glucose level at lower dosage than degludec. GEM229 shows better blood glucose control than degludec by once daily injection and better blood glucose control than degludec by every other day (Q2D) injection for 30 days. GEM229 causes a significant reduction in HbA1C level after treating for 60 days
11/25/20	GEM228	GLP-1 with fatty acids bundles	Type2 Diabetes, obesity; NASH	s.c.	Peptide conjugated fatty acid	Metabolic Disease	Preclinical	GEM228 -can be produced in high quality. -can lower blood glucose better than semaglutide and effectively control blood glucose level at 10 nmol/kg - can effectively reduce body weight and reduce liver fat
11/25/20	GEM227	Octreotide with fatty acids bundles	carcinoid syndrome/ acromegaly	s.c.	Peptide conjugated fatty acid	Endocrinology Gynecology	Preclinical	GEM227 - can be produced in high quality and bind to HSA effectively. - Fatty acids bundle can effectively prolong serum half-life of octreotide and antiproliferative effect of GEM227 is similar to that of octreotide. - can effectively reduce serotonin level in xenograft mouse model.

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11/25/20	GEM226	Anti-fibrin scFv with reteplase	Pathological Clots	i.v.	Antibody conjugated reteplase	Endocrinology	Preclinical	GEM226 - can bind to human fibrin/crosslinked fibrin, but not to fibrinogen and bind to human fibrin under high concentration of fibrinogen. -GEM226 is stable in buffer at 4°C and alteplase showed similar enzyme kinetics to tPA substrate, also can dissolve clots effectively, accumulate at the clot in vivo and bind to human clots specifically -GEM226 has better PK profile in rat and shows better clot-dissolving effect than that of alteplase in MCAO mice model. -GEM226-treated MCAO stroke mice have better neurobehavior than the mice treated with alteplase
11/24/20	GEM225	Regulating the cellular pathway that differentiates cancer cells, leading to apoptosis and cancer arrest	Triple negative breast cancer, Pancreatic cancer	i.v.	Protein	Oncology: Solid cancer	Preclinical	- GEM225 is a recombinant human KL-1 (rhKL-1). - KL-1 is the domain with the anti-cancer activity of Klotho, a hormone with tumor suppression activity. - Klotho expression in epigenetically silenced in malignant tissues. - rhKL-1 inhibited tumor growth in-vivo. - rhKL-1 demonstrated acceptable safety profile in the in-vivo studies. - rhKL-1 can provide effective and safe solution where currently approved treatments fail.
10/15/20	GEM223	Regulation of cellular phosphate handling and intracellular energy status	Hyperphosphatemia in chronic kidney disease (CKD) Chemotherapy-induced hyperphosphatemia (Tumor Lysis Syndrome, TLS)	Oral Intravenous	Small molecule	Oncology: Supportive care Renal disease	Pre-IND	First-in-class drug with a new MOA that is completely different from those of existing drugs for the treatment of hyperphosphatemia in CKD and TLS, a serious complication in cancer patients. - A unique and highly effective mechanism to reduce blood phosphate levels in mammals - Once-daily dosing potential - No gastrointestinal side-effects - Mechanism-based kidney protective effects - IND-enabling 4-week toxicological studies have been finished
09/08/20	GEM221	Anti-Globo H ADC	Cancer	i.v.	Antibody	Oncology: Solid cancer	Preclinical	High affinity, fast internalization, good in vitro cytotoxicity - Showed great tumor growth inhibition (>90%, 3 mg/kg) in HCC-1428 animal models without any body weight loss - Can be prepared reproducibly at gram scale.
09/08/20	GEM220	Anti-Globo H Antibody	Breast Cancer	i.v.	Antibody	Oncology: Solid cancer	*Preclinical **Discovery	* Anti-Globo H monolonal antibody - Higher patient population in breast cancer (61%). - Anti-cancer efficacy demonstrated in breast cancer animal model through ADCC and CDC. **Anti-Globo H bispecific antibody - High correct pairing (>95%) -Target cell-dependent T cell activation (Better safety profile). - Anti-cancer efficacy demonstrated in breast cancer animal model through T cell-mediated cytotoxicity.
09/08/20	GEM219	Anti-TIM-3 antibody	Cancer	i.v.	Antibody	Oncology: Solid cancer	Preclinical	GEM219 is a fully human anti-TIM-3 antibody with high affinity in vitro and cell-based binding assay. - The anti-TIM-3 antibodies are also highly functional in cellbased bioassay. - Some anti-TIM-3 antibodies have cross-species recognition ability to mouse TIM-3. - Animal efficacy studies are in progress

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09/08/20	GEM218	Anti- Human PD-L1 antibodies	Cancer	i.v.	Antibody	Oncology: Solid cancer	Preclinical	GEM218 is a novel monoclonal antibody that specifically binds to PD-L1 with high affinity and effectively blocks PD-1/PD-L1 interaction. - Can be well detected by the PD-1/PD-L1 Blockade Assay. - Novel binding epitopes. - Good potential for a companion diagnosis. - The efficacy and toxicity are studied in various in vitro and in vivo models
09/08/20	GEM215	Globo H-Specific CAR-T Cells	Solid Tumor: breast cancer, gastric cancer and lung cancer	i.v.	Cell therapy	Oncology: Solid cancer	Discovery	Potential cell therapy for Globo H+ solid tumor. -Combination with anti-PD-L1 Ab overcomes PD-L1-mediated immune suppression on CAR-T cells in tumor microenvironment. -Anti PD-L1 Ab is able to induce bystander effect during Globo H CAR-T cell treatment.
09/08/20	GEM214	Anti-K. pneumoniae (KP) Antibodies	Multiple Drug Resistant (MDR) Klebsiella pneumoniae (KP) infection	i.v.	Antibody	Infection	Preclinical	GEM214 is an anti-MDR therapeutic antibody against Klebsiella pneumoniae Infection. -A fully human mAb, has longer half-life and low immunogenicity. -Antibody Antibiotics Conjugate (AAC) of GEM214 shows dose dependent intracellularly bactericidal potency.
09/08/20	GEM213	Anti-CSF-1R antibody	Cancer, PVNS (pigmented villonodular synovitis)	i.v.	Antibody	Immunology/Inflammation Oncology: Solid cancer	Preclinical	GEM213 is an antibody with high affinity and neutralizing ability. - GEM213 can potently inhibit Colony Stimulating Factor Receptor 1 (CSF-1R) in cellular contexts and has the potential to induce a therapeutic effect on macrophages. - GEM213 has unique CDR sequences and epitopes. - GEM213 is a promising new agent with potential to combine with immune checkpoint inhibitors to relief macrophage-dependent immune suppression and would yield clinical benefit.
09/03/20	GEM-CDV07	CK2 inhibitor	COVID-19	Oral	small molecule	Infection	IND#	- A promising therapeutic compound due to its dual impact on COVID-19 *Block stress granule disaggregation required for active viral replication *Reduce cytokine storm - GEM-CDV07 demonstrates potent anti-SARS-CoV-2 activity. - In process of filing for emergency IND (eIND) to U.S. FDA to test ten patients. #Phase 2 clinical trial is ongoing for other indication.
08/26/20	GEM212	Antivirulent approach targeting antimicrobial resistance of *Staphylococcus aureus* infections	*S. aureus* and MRSA	Oral	Small molecule	Infection	Near completion of IND stage	An antivirulent, non-bactericidal small molecule drug candidate for *S. aureus* infections, including MRSA, in a first-in-class oral form. Potentially reduces the risk of *S. aureus* resistance. A new mechanism to enhance the killing action of neutrophils. Phase II clinical trials are planned across multiple indications; bacteremia, pneumonia, endocarditis, bone and joint infections
08/26/20	GEM211	Antiviral	Influenza A	Oral	Small molecule	Infection	Lead optimization stage	An antiviral with a more upstream target than Tamiflu, shown to be more effective *in vivo* . A small molecule, nucleozin, which targets viral nucleoprotein (NP), triggering the aggregation of NP and inhibiting its nuclear accumulation. This impedes viral replication *in vivo.*
08/26/20	GEM210	TFEB activation	Alzheimer's and Parkinson's disease	Oral	Small molecule	CNS	Lead optimization stage	A new mechanism of action (and first-in-class oral form) to accelerate the degradation of neurotoxic proteins by autophagy. mTOR independent autophagy targets the removal of multiple misfolded proteins (e.g. beta-amyloid, tau) In several neurodegenerative diseases, mTOR/Transcriptional factor EB (TFEB) and therefore autophagy is dysfunctional. GEM210 increases TFEB translocation to the nucelus and enhances autophagy.
08/26/20	GEM209	A3 adenosine receptor (A3AR) allosteric modulator	Erectile dysfunction	Oral	Small molecule	Immunology/Inflammation Urology	Preclinical	・Specific agonists of A3AR induce modulation of key signaling proteins, such as PI3K, GSK-3β, PKA, PKB/Akt, IKK, and NF-κB, and show anti-inflammatory effects. ・Very good safety profile. ・GEM209 increased eNOS and VEGF in the cavernosal endothelial cells. ・A single dose showed a full recovery in function of in an erectile dysfunction rat model.

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08/26/20	GEM208	A3 adenosine receptor (A3AR) agonist	Liver cancer* NAFLD**	Oral	Small molecule	Matabolic disease Oncology: Solid cancer Rare disease	Phase 3 in preparation* Phase 2 completed**	・A3AR is highly expressed in inflammatory and cancer cells. Specific agonists of A3AR induce apoptosis of cancer cells but not normal cells. ・Very good safety profile. ・An orphan drug status for hepatocellular carcinoma (HCC). ・In phase-2 study in HCC patients, it did not meet the primary endpoint (OS) but subgroup analysis of Child Pugh B patients showed a positive signal of efficacy for OS. ・In phase-2 study (vs placebo) in NAFLD/NASH, it met primary endpoint (liver enzyme) and reduced liver fat, fibrosis and steatosis. .
08/26/20	GEM207	A3 adenosine receptor (A3AR) agonist	Rheumatoid arthritis (RA), Psoriasis	Oral	Small molecule	Dermatosis Immunology/Inflamation Orthopedic Rhuematology	Phase 3	・A3AR is highly expressed in inflammatory and cancer cells. Specific agonists of A3AR induce apoptosis of inflammatory cells but not normal cells. ・Very good safety profile as 1st line therapy. ・In the pahse-2b study (monotherapy vs placebo) for12 weeks in naive RA patients, the endpoint was achieved. ・In the pahse-2/3 study (monotherapy vs placebo) in moderate to severe psoriasis patients, it did not meet the primary endpoint at 12 weeks, but at 32 week the improvement of PASI score was significant vs at 16 week. ・A phase-3 study (vs MTX) in moderate to severe RA and a phase-3 study (vs apremilast) are ongoing.
08/24/20	GEM206	FLT3 Kinase Inhibitor	Acute myeloblastic leukemia (AML)	Oral	Small molecule	Oncology: Hematological cancer	Preclinical	- Novel chemical structure distinguished from known FLT3 inhibitors - Highly potent against FLT3 and FLT3 mutants (overcome FLT3-TKD mutation mediated drug resistant) - Highly selective - Monotherapy & orally active - Well-tolerance in preclinical tox study - GLP tox study is in progress.
08/24/20	GEM205	Anti-Mesothelin (MSLN) Antibody-Drug Conjugate (ADC)	Cancer (Pancreatic Cancer, Ovarian Cancer etc.)	Injection	Antibody	Oncology: Solid cancer	Preclinical	- Mesothelin is a differentiation antigen overexpressed in many solid tumors - GEM205 showed great tumor growth inhibition (>90%) in animal model without body weight loss. - GEM205 also showed great efficacy in large tumor model (>500 mm3). - Self-owned I4 technology was applied in GEM205. - GEM205 showed uniform DAR (4), high affinity, good cytotoxicity.
08/24/20	GEM192	Selective PI3Kα inhibitor	Slow-flow vascular malformations	Oral	Small molecule	Rare disease	Phase 1	Slow-flow vascular malformations including venous malformation, lymphatic malformation, Klippel-Trenaunay syndrome is abnormal clustering of blood vessels that occurs in children or young adults and are caused by PI3K pathway GOF mutation. By selectively inhibiting PI3Kα isoform, GEM192 inhibits angiogenesis, but not immune function resulting in better therapeutic effects and lower infectious risk. Phase 1/2 data for another indication demonstrate a favorable tolerability profile. Clinical development to be pursued with new pediatric formulation

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06/04/21	GEM185	GLP-1/GIP dual agonist	Obesity, diabetes	s.c.	Peptide	Metabolic disease	Phase 1	GEM185 is an injectable (QD) dual agonist for GLP-1R and GIPR. Preclinical studies have shown that GEM185 is more effective in improving diabetes and obesity than GLP-1R agonism only. In addition, GEM185 has been shown to improve liver parameters in diabetic and obesity conditions in preclinical research. Hence, GEM185 may be superior to the GLP-1R agonist in improving diabetes, obesity, and non-alcoholic steatohepatitis (NASH). In a preclinical study, GEM185 showed better efficacy in improving glycemic control and an almost same efficacy in decreasing body weight compared to tirzepatide, a Lilly's Ph3 program. A long-acting formulation, which is likely to maximize its therapeutic efficacy, are under development. A phase 1 study (first-in-human study) started in 2020 in the UK. No longer available for licensing to Asia/Pacific excluding Japan.
08/12/20	GEM204	Multi-molecular targeting including the Wnt/β-catenin pathway	Hair loss, Androgenetic Alopecia, Telogen effluvium, Senescent Alopecia	Topical and/or oral	Plant extracts	Dermatosis	Commercial	GEM204 is a comprehensive solution for the treatment of hair loss, targeting more than 21 hair regulating molecular pathways to promote hair growth and inhibit hair loss. Market approval and full scientific dossier available with clinical trials in women and men of all hair loss patterns, hair types and skin types.
08/10/20	GEM203	FXR agonist and 5-HTR2A antagonist	NAFLD, Type 2 diabetes, obesity, dyslipidemia and hypertension	Oral	Small molecule	Cardiovascular Metabolic disease	Preclinical	First in class single molecule having both FXR agonistic and 5-HTR2A antagonistic actions. In DIO mice, GEM203 reduced hyperglycemia, hyperinsulinemia, insulin resistance and liver lipid contents to similar or greater extent vs metformin. GEM203 reduced the body excess weight while metformin did not. In NASH model mice, GEM203 reduced liver excess weight, TG and TC contents, plasma ALT and AST, inflammation and collagen gene expression in the liver. Strong IP portfolio with long expiry dates granted in major markets.
08/05/20	GEM202	Somatostatin receptor subtype 5 (SSTR5) antagonist	Type 2 diabetes, Gallstone, Primary sclerosing cholangitis (PSC), Inflammatory bowel disease (IBD), short bowel syndrome (SBS)	Oral	Small molecule	Endocrinology Gastroenterology Metabolic disease	Phase 1	SSTR5 is primarily expressed in pancreatic ß-cells and enteroendocrine cells, and its ligand, somatostatin, negatively regulates the secretion of insulin and gut hormones (GLP-1, GLP-2, PYY, etc.). GEM202 is a selective SSTR5 antagonist and is unique owing to its dual action of elevating these hormone secretions and increasing insulin sensitivity, thereby improves glycemic control in obese and diabetic mice. In addition, GEM202 is effective in stimulating gallbladder motility and increasing bile flow, accounting for its therapeutic effects in animal models of gallstones and PSC. Thus, an additional potential application involves treatment of hepatobiliary diseases. Patents have been filed globally.
08/01/20	GEM201	mRNA Vaccine Platform technology. Production of S-Protient with Immune-modulators in one construct.	Coronavirus (COVID-19); Broader Vaccine Platform	i.v.	Drug Delivery, Cell therapy	Infection Vaccine	Preclinical	GEM201 utilizes TGEM055 technology loaded with antigenetic proteins as a mRNA Vaccine Platform - Produce functional antigenetic protiens in Lymphatic organs - Localized antigen induction at high intracellular amounts where antigen presenting cells aggregate. Co-delivery of potent Immune-modulators (GM-CSF, IL-12, etc) sumultaneously - GEM201 is a vaccine platform - GEM201 is critical for vaccination of elderly and immune suppresed populati

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07/22/20	GEM200	Physically damage bacterial membranes	Multidrug-resistant bacteria	i.v.	Peptide	Infection	Preclinical	A bioengineered peptide that is effective against Gram(-) bacteria and works regardless of any underlying resistance the bacteria may have against other antibiotic drugs. GEM200 is highly efficient against Multi Drug Resistant Acinetobacter baumannii in hospital acquired infections and its unique MoA lowers the probability for development of future resistance or tolerance. GEM200 is Effective where the Standard of Care drugs fail. Advantages: - High effecacy in systemic IV administration - Rapid bactericidal MOA that avoids resistance - Targets bacteria only – Non-toxic to human cells - Stable peptides with T1/2=~8 hours in human plasma
07/08/20	GEM199	A fixed dose combination of Minoxidil, resveratrol and melatonin.	Alopecia / Hair Loss	Topical	Small molecule	Dermatosis	Pre registration	Minoxidil is a potassium channel blocker that prevents hair loss by improving blood flow to the hair follicle. It also suppresses androgen receptor function and stimulates the production of prostaglandins. Resveratrol stimulates hair growth by decreasing prostaglandin D2 (PGD2) and increasing prostaglandin E2 (PGE2). Melatonin is a neurohormone involved in multiple physiological processes underlying circadian rhythm. Due to its antioxidant properties, melatonin has remarkable protective effects on cells and anti-apoptotic properties. Hence the association between melatonin and hair growth. The effect of melatonin on hair growth may be moderated by an interaction with androgens and estrogens and their receptors. Results from a clinical study demonstrated that GEM199 was more effective at stopping hair loss than Minoxidil. US patent issued, and international patents have been filed.
07/08/20	GEM198	A fixed dose combination of melatonin and resveratrol.	Alopecia / Hair Loss	Topical	Small molecule	Dermatosis	Pre registration	Resveratrol stimulates hair growth by decreasing prostaglandin D2 (PGD2) and increasing prostaglandin E2 (PGE2). Melatonin is a neurohormone involved in multiple physiological processes underlying circadian rhythm. Due to its antioxidant properties, melatonin has remarkable protective effects on cells and anti-apoptotic properties. Hence the association between melatonin and hair growth. The effect of melatonin on hair growth may be moderated by an interaction with androgens and estrogens and their receptors. Results from a clinical study demonstrated that GEM198 was more effective at stopping hair loss than Minoxidil. US patent issued, and international patents have been filed.
07/08/20	GEM197	A fixed dose combination of minoxidil, finasteride and latanoprost.	Androgenetic alopecia	Topical	Small molecule	Dermatosis	Phase 3	Minoxidil is a potassium channel blocker that prevents hair loss by improving blood flow to the hair follicle. It also suppresses androgen receptor function and stimulates the production of prostaglandins. Finasteride is a 5 alpha reductase inhibitor that reduces the conversion of testosterone to dihydrotestosterone (DHT), which in turn reduces the binding of DHT to the androgen receptor, thereby reducing the miniaturization of the hair follicle. Finasteride also upregulates SULT1A1, which activates the pro-drug of minoxidil into its active form - minoxidil sulfate Latanoprost is a prostaglandin analogue that has a positive stimulatory effect on the hair follicle and induces the conversion from telogen to anagen phase in the hair growth cycle. Results from a completed phase 2 study have demonstrated thatGEM197 is a well-tolerated, once a day, topical fixed dose triple combination therapy that stimulates new hair growth and prevents further hair loss for the treatment of androgenetic alopecia in men 24-65 years old. The FDA has given a roadmap to start a Phase 3 clinical trial under 505(b)(2). International patents have been issued.

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06/26/20	GEM196	Potassium-Competitive Acid Blocker (P-CAB)	Peptic ulcer	Oral	Small molecule	Infection	Phase 2 completed	Phase 3 is ongoing.P-CABs are the best treatment with better and fater efficay for gastric acid-related gastrointestinal diseases such as gastric and duodenal ulcer, GERD, NERD, ZES and etc. GEM196 is a potentially best-in-class P-CAB - Faster clinical benefit in phase 2 study compared with Lansoprazole for duodenal ulcer treatment. - Rapid and high absorption, oral bioavailability in clinical study. - Lower toxicity and better PK, PD than TAK-438. - Acid stability- exempt acid protection - Longer lasting-higher concentration on target site - Less individual differences- isoenzyme CYP2C19 metabolism tiny dependence.
06/18/20	GEM-CDV06	A potent DNA-immunotherapy against SARS-CoV-2	COVID-19	Intravenous Injection	In vivo CAR-T	Infection	Preclinical	DNA vector with Anti-CoV-2 Receptors inserted into our original platform (TGEM052) and delivered through liposomes into lymph nodes. The plasmid moves into the nucleus of normal T-cells and converted to CAR. Anti-CoV-2 CAR T-cells attack the virus and diseased cells and destroy them.
06/18/20	GEM195	A potent DNA-immunotherapy for MAGE A	Triple Negative Breast Cancer (TNBC)	Intramuscular Injection	DNA Plasmid	Oncology: Solid cancer	Preclinical	DNA vector with MAGE A inserted into our original platform (TGEM052) and delivered into muscle cells using intramuscular injections followed by electroporation. The plasmid moves into nucleus of muscle cells and starts to over-express MAGE A, eliciting an immune response that can target MAGE A on cancer cells and destroy them.
06/18/20	GEM194	PDE4 inhibitor	Autoimmune dermal disorders (bullous pemphigoid, psoriatic arthritis)	Oral	Small molecule	Dermatosis Immunology/Inflamation	Phase 1	GEM194 is the best-in-class PDE4 inhibitor having potentially a wider therapeutic index compared to clinically efficacious and marketed PDE4 inhibitors such as apremilast and roflumilast. Bullous pemphigoid (BP) is chronic autoimmune skin disorder resulting in generalized, pruritic, bullous lesions in elderly patients currently treated with corticosteroids and multiple antibacterial agents. Anti-inflammatory profile of PDE4 inhibition associated with multiple immune- and inflammatory cells is anticipated to taper doses of systemic corticosteroid. Opportunities exist to extend clinical development for other inflammatory dermal indications such as psoriatic arthritis.
06/18/20	GEM193	PDE4 inhibitor	NASH	Oral	Small molecule	Gastroenterology Immunology/Inflamation Metabolic disease	Phase 1	GEM193 was efficacious in reducing plasma ALT levels, hepatic fibrosis area, TG levels in an animal model of NASH. In addition, GEM193 exhibited anti-obesity and anti-diabetic properties in vivo. PDE4 enzyme is expressed not only in disease-relevant cell population, but also in ubiquitously whole body and its inhibition results in anti-inflammatory, anti-fibrotic and anti-metabolic effects that fit favorable profile as a monotherapy for NASH.
06/18/20	GEM191	Potentiation of detrusor contraction	Underactive bladder	Oral	Small molecule	Urology	Phase 1	Detrusor underactivity is a main cause of underactive bladder, which causes multiple lower urinary tract symptoms such as residual urine and urinary tract infection. GEM191 potentiates detrusor contraction and shows no impact on bladder storage function or urethral function. Stratified analysis clearly indicates efficacy to reduce residual urine in patients with detrusor underactivity.
06/15/20	GEM190	Lipase inhibition, α-amylase inhibition, aldehyde dehydrogenase (ALDH) activation and anti-oxidant capacity increase	Overweight and obesity Alcohol and tobacco smoke toxicity	Oral	Natural product	Metabolic disease	Clinical	GEM190 is a combination of two purified plant extracts in a form of oral liquid food supplement developed for appetite and weight control. Also, it reduces alcohol and tobacco smoke toxicity by activation of aldehyde dehydrogenase (ALDH) and increasing anti-oxidant capacity. In overweight and obese patients, GEM190 showed significant suppression of appetite and reduction of body weight and body fat as well as it had a beneficial effect on fluid distribution during weight loss, as observed in 12-week treatment. Increased ALDH activity in PBMC was observed already after 24 hours after initiation of GEM190 administration. GEM190 may provide a salvage solution in populations known to be particularly susceptible to a build-up of excess acetaldehyde, such as having a ALDH2*2 genetic mutation. GEM190 claims are under two PCT applications.

Drug Candidates

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Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
06/05/20	GEM-CVD05	Immune-modulate and slow down the hyperactive active immune system from attacking lung cells (and other solid organs)	Prevention of Respiratory Falure by Treating Acute Respiratory Disease Syndrome Resulting from COVID-19 and other viral pandemics	Refer to Note*	Protein**	Immunology/ Inflammation Infection Respiratory	Phase 3 ready***	1. Treatment of blood/MSCs, Tregs, NK cells with GEM-CVD05 to improve their homing to patients' lungs, thereby enabling those cells to slow down the hyperactive immune attack on the lungs to help prevent deaths from respiratory failure. 2. Treatment of cells such as stem cells enabling them to home/engraft more effectively to the bone marrow and accelerating immune reconstitution with 'younger' immune cells for improved viral infected cell killing. *Infusion with blood, or MSCs, Tregs, NK cells to improve efficacy, safety and cost of care outcomes **Used to treat MSCs, Blood, Tregs, NK cells , Stem Cells to Prevent deaths from respiratory failure ***Phase 2 study for other indication has been completed.
06/05/20	GEM189	Nanoliposome-encapsuled Radionucleotide	*Recurrent Glioblastoma, **Multiple tumor	Intratumoral	Radionucleotide	Oncology: Solid cancer	*Phase1, **Preclinical	Radionuleotide in GEM189 is ideal one for the treatment of solid Tumors. It delivers a high dose of radiation directly to the tumor while sparing normal, healthy brain tissue, stays at the tumor for several days and Effect lasts for several days and then dissipates. No serious adverse events observed to date. Key advantages over External Beam Radiation Therapy: -At least 500 Gy, -Single 4-day hospitalization -Able to more effectively treat tumor margins - Limited toxicity -Able to verify successful delivery with SPECT scan
06/05/20	GEM188	Dual inhibitor of ROCK and new target kinase	Glaucoma; ocular hypertension	Small molecule	Topical eye drop	Ophthalmology	Preclinical	GEM188, a dual ROCK/new target kinases inhibitor, had shown more effective in intraocular pressure lowering than competitor netarsudil in magnetic bead-induced and hypertonic saline-induced ocular hypertensive models. Moreover, GME188 also showed lower eye irritation than netarsudil in New Zealand White rabbit. The plasma exposure by eye drops dosing was less than that by iv dosed with NOAEL. The preclinical studies including GMP-compliance production, GLP toxicology, etc., is ongoing in 2020.
05/30/20	GEM187	Mesenchymal stem cell	Rheumatoid Arthritis (RA), Inflammatory Bowel Disease (IBD), COVID-19	Implant (allogenic)	Cell	Gatroenterology Immunology/Inflammation Infection Regenerative medicine Rheumatology	IND	GEM187 is a fresh (non-frozen) human allogenic umbilical cord tissue derived mesenchymal stem cells (hUC-MSC) product. - Proprietary manufacturing process with no risk of contamination. - "Youngest" adult MSC with robust proliferation capacity. - Highly scalable to achieve enough cells. - Superior biological functions: optimal cell viability and biological functions maintained for therapeutic use.
05/12/20	GEM184	GPR40 full agonist	Obesity, diabetes, NAFLD/NASH	Oral	Small molecule	Metabolic disease	Phase 1	A first-in-class GPR40 full agonist stimulating multiple islet (insulin, glucagon) and gut hormones (GLP-1, GIP, and PYY). GEM184 is much more effective in improving glucose control than DPP-4 inhibitors and in preclinical models. In addition to glucose-lowering effects, GEM184 effectively decreases body weight in overweigh condition via stimulating gut hormones. By binding to a site independent of the fasiglifam binding site, GEM184 induces a similar therapeutic efficacy with much lower exposure (~1/270) compared to fasiglifam in diabetic models. A lower plasma exposure mitigates the risk of side effects including liver toxicities reported with fasiglifam. In addition, glucagon an GLP-1 stimulation by GEM184 induces therapeutic benefits on NAFLD/NASH conditions, in which DPP4 inhibitor and SGLT2 inhibitor were almost ineffective.

Drug Candidates

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Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
05/12/20	GEM183	Direct renin inhibitor (DRI)	Blood pressure control and/or prevention of heart failure in patients with chronic hemodialysis	i.v.	Small molecule	Cardiology Renal disease	Preclinical	Injectable formulation of GEM182 (oral formulation in phase-2b), is also being developed for potential use for better blood pressure control and/or prevention of heart failure by chronic intravenous treatment three times per week via vascular access established in patients with chronic hemodialysis. Renin inhbitor may be suitable for such patients who often exhibit hyperreninemia potentially due to residual function of juxtaglomerular apparatus as well as reduced renal blood flow after start of the hemodialysis. Although dialysis patients are mostly unavoidable from hypertension, no optimal treatment has been available yet. GEM183 can fulfill such such rapid growing huge unmet medical needs. Licensing discussion is available except for China.
05/12/20	GEM182	Direct renin inhibitor (DRI)	Hypertension (HP), diabetic nephropathy (DKD), chronic hemodialysis, heart failure	Oral	Small molecule	Cardiology Renal disease	HP : Phase 2 ready, DKD: Phase 3 ready	A 2nd generation DRI with better renoprotective effects than ACEi/ARB. Better hypotensive effects than aliskiren is expected due to higher BA, less variability and no food effect following oral treatment. Prolonged renal localization, blood pressure independent renoprotection and positive effect on renal blood flow are evidenced by DRIs. In clinical trials of GEM182 in T2DM patients with microalbuminuria, dose-dependent UACR reduction and increases in remission rate from albuminuria were also seen. This compound have been developed as mono-therapy (not combined with ACEi/ARB). Therefore, GEM182 has no safety issues seen in aliskiren's ALTITUDE trial due to RAS dual brockade. Injectable formalution is also developed (ref. GEM183). Licensing discussion is available except for China.
05/11/20	GEM181	Selective HDAC8 inhibitor	Solid tumor	Oral	Small molecule	Oncology: Solid cancer	Phase 1	Through several mechanisms exhibited tumor inhibitory activity against many cancers, especially with high HDAC8 protein expression. Advantages of GEM181 - Able to pass the BBB - Suppresses angiogensis - Side effects less than those of curretly marketed drugs - Simple synthetic method
05/08/20	GEM180	Contrasting	MRI Contrasting	i.v.	Nano particle	Diagnosis	Phase 2	GEM180 is a MRI contrast medium which can detect more small liver lesion, compared to marketed product, because of the better contrast. Biopsy confirmed the number of small nodules by GEM180. GEM180 has better imaging results (higher percent signal intensity loss (PSIL) and better consistency) from CT001. So far no obvious severe adverse events seen. Comprehensive patent portfolio exist globally.
05/08/20	GEM179	Iron supply	Iron deficient anemia	i.v.	Nano particle	Hematology	Phase 2	GEM179 is a PEGylated Iron oxide nano particle (IOP) with high macropharge uptake efficiency. GEM179 provide higher efficacy and better safety profilres (serum iron, ROS, hypersensitivity, iFGF23). Comprehensive patent portofolio exist globally.
05/01/20	GEM-CVD04	- Antiviral - Immunomodulatory - Anticoagulant - Cytokine release control	Pre-Exposure and Post Exposure Prophylaxis for COVID-19	Oromucosal (dissolves in the mouth)	Small molecules	Infection	Phase 1*	- Multi-targeted action - Systemic absorption and topical exposure to upper respiratory tract. colonized by COVID-19 virus. - *Entering Phase 2 for other indication (USA). - Available for a large clinical trial (GMP). - Excellent safety profile - Worldwide patents

Drug Candidates

GEMSEKI

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Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
04/27/20	GEM-CVD03	Fast response oral vaccine	COVID-19	Oral	Vaccine	Infection Vaccine	Phase-1/2	First-in-class COVID-19 immunotherapy to be used as an oral vaccine. This company has a track record to manufacture oral vaccine against highly pathogenic avian flu virus H5N1 on one week time. Oral vaccine will be easier to distribute to a large number of potentially virus-exposed people within very short period of time. The company is looking for partner who make the company accessing the virus and finance to manufacture the first batch within one week.
04/27/20	GEM177	BOTOX Biosimilar	Refer to Note	Injection	Protein	CNS Ophthalmology Pain/Neuropathy Urology Others	Preclinical	Equivalent efficacy and similar safety profile (for biosimilar for Allergan Botox) Manufacturing using plant-derived mediums Inidication - Therapeutic applications: strabismus, cerebral palsy, cervical dystonia, neurogenic bladder, migraine, facial spasm, blepharo spasm - Aesthetic application: all wrinkles produced due to persistent muscular contractions, square jaw reduction, hyperhidrosis
04/27/20	GEM176	A new anti-angiogenesis drug	Solid tumor* and Retina disorder **	Injection	Protein	Oncology: Solid cancer Ophthalmology	Preclinical	Best-in-class product against anti-VEGF agents The fusion protein of the second domains from VEGF receptor-1 and the Fc portion of human IgG1. Higher avidity for VEGF/PLGF and low immunogenicity and side effect. *More complete blockade of Tumor growth. (pancreatic cancer, liver cancer, gastric cancer, non-small cell lung cancer) **Longer duration of action (wet AMD, Diabetic macular edema, retinal vein occlusion, diabetic retinopathy)
04/24/20	GEM175	Elevates RPE phagocytic function to clear retinal drusen (lipoprotein deposits) and reduce oxidative stress	Intermediate AMD	Oral	Small molecule	Ophthamology	Phase 2 ready	Novel high-dose reformulation of statin previously marketed as a lipid lowering drug, now developed for the new use of treating intermediate AMD. POC clinical trial showed a marked clearance of drusen and a 75% reduction in progression to late AMD (CNV/GA). Abbreviated 505(b)(2) pathway. Patent applications have been made globally.
04/24/20	GEM174	Invadopodia-Targeted siRNA	Advanced and/or highly metastatic cancers*	i.v.	Nucleic acid	Oncology: Solid cancer	Pre-IND	Invadopodia mediates cancer cell invasion, intravasation and extravasation. Master Invadopodial Regulators (MIRs) are the driver genes of cancer invasiveness and metastasis and are rarely expressed by normal cells. MIR-1 is also a cardinal regulator of Wnt activity and tumor growth. GEM174 is a lipid nanoparticles-formulated siRNA specifically targeting MIR-1. GEM174 suppressed many tumor growth and extended survival time in xenograft model. *hepatocellular carcinoma, triple-negative breast cancer, and gastric adenocarcinoma
04/22/20	GEM173	Anti-fibrotic effects	Anti-Fibrotic-Treatment of patients after Aortic-Valve-Implantation	Oral	Small molecule	Cardiology	Phase 1	Combibnation of marketed small molecure drugs to exert anti-fibrotic effects. A novel anti-fibrotic therapy is supposed to reduce progression of fibrosis and stabilize heart functioning. Myocardial fibrosis was found to independently predict cardiovascular mortality after AVI. Patent application has been made globally. Discussions are available for Japanese companies and Chinese companies.
04/22/20	GEM172	Activation of multiple sulfatase	Multiple Sulfatase Deficiency	Oral / or injection	Small molecule	CNS Metabolic disease Orthopedic Rare disease	Preclinical – Phase 1 study in preparation	No effective treatment for the rare disease MSD is available. Combination of marketed drugs increase the activity of multiple sulfatases and significantly reduce toxic glycosaminoglycans in MSD fibroblast cell lines. Priority patent, which lead to global application, has been filed. Discussions are available for Japanese companies and Chinese companies.
04/22/20	GEM171	ARNT regulation	Fibrosis in kidney, heart and liver	Oral / or gene therapy	Small molecule or morpho-linos	Cardiology Metabloic disease Urology	Discovery – Preclinical	No effective therapy for fibrosis is available yet. ARNT homodimerizartion attenuates fibrosis progression and induces regenerative cellular responses. Several mechanisms of action and potential drugs were identified, which show inhibition of ARNT degradation or activation of ARNT expression. PCT pattent application filed. Discussions are available for Japanese companies and Chinese companies.

Drug Candidates

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Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
04/22/20	GEM170	Improved PCR	Diagnostic for detection of Paratuberculosis in animals and potentially Crohn's disease in humans	in vitro	Others	Diganosis Gatroenterology Infection	POC obtained in animals	New and improved PCR diagnostic test for fast and early detection of Mycobacterium avium subspecies paratuberculosis (MAP). This method shows better performance than current ELISA as well as on current PCR tests. Diagnostic test for early MAP detection in domestic livestocks, exotic ruminations and human patients. Discussions are available for Japanese companies and Chinese companies. * Successfully tested in feces, blood, milk, sperm and tissue samples
04/16/20	GEM-CVD02	Immune modulation (reduction of cytokine storm) with anti-viral medicine	COVID-19	Oral	Small molecule	Immunology/ Inflammation Infection	Launch	COVID-19 progressing process is by first infecting from the virus and intriguing immune system modulated pro-inflammation, further proceeding to more serious inflammation, and later evolving to commencement of pro-fibrosis with infected pneumonia.TLR4 signaling pathway is closely associated with inflammation, immunity, and lung diseases. A TLR4 antagonist works well as an immune modulator for applications on pro-inflammatory diseases. GEM-CVD02 is a launched compound that has TLR4 antagonist activity and is expected the efficasy in combination of anti-viral medicine. GMP manufactured and FDA approved CTM capsules of this candidate are ready for clinical trial uses.
04/10/20	GEM-CVD01	SARS-CoV-2 spike protein expression from RNA followed by antibody response	COVID-19	Intramuscular	RNA Vaccine	Infection Vaccine	Preclinical	This program is a rapid COVID-19 vaccine development. This vaccine is developed on the basis of established technologies of RNA delivery and nanostructured lipid carrier formulation. GEM-CVD01 rapidly induces robust immune responses.
04/10/20	GEM168	Heat-killed mycobacterium vaccae	Tuberculosis (TB)	Oral	Vaccine	Infection Vaccine	Phase 3	First-in-class tuberculosis immunotherapy to be used as an oral adjunct to standard TB drugs. In a 1-month phase 2 trial, the mycobacterial clearance in sputum smears was observed in 72% and 19% of patients on GEM168 and placebo, respectively.
04/08/20	GEM167	Elimination of MADD protein	Solid tumors	i.v., intra-tumoral	Gene therapy	Oncology: Solid cancer	Preclinical	A systemically deliverable oncolytic viral vector to target and eliminate the MADD protein overexpressed in a wide range of human cancer cell lines and involved in resistance. Systemic delivery demonstrated to colon, breast, liver, and ovarian tumors with no liver or kidney damage. Our parental vector infects and replicates only in cancer cells and has undergone extensive distribution and toxicity studies in mice and baboons and was previously approved for human trials. Breast, liver, and anaplastic thyroid cancer using siRNA achieved 41-60% TGI as mono or combo therapy.
03/31/20	GEM166	Anti-Nodal antibody	Melanoma, Breast cancer, Pancreatic cancer and Hepatocellular carcinoma	i.v.	Antibody	Oncology: Solid cancer	Preclinical	The first anti-Nodal antibody drug targeting cancer stem cells and aggressive tumors. Nodal is a secreted protein in the embryo. The expression is lost in most adult tissues, but is reactivated in aggressive tumor cells. Expression level is highly correlated with invasion, metastasis, drug resistance and cancer prognosis. Combination of anti-Nodal Ab with current therapies is more effective than monotherapy. A companion diagnostic Nodal ELISA kit is also being developed which can be used as a biomarker for patient selection and disease monitoring.
03/25/20	GEM035	An anti-ENO1 antibody	Immune diseases, Various cancers	s.c.	Protein	CNS Gastroenterology Immunology/ Inflammation Infection Oncology: Solid cancer Respiratory Rheumatology	US FDA IND cleared	GEM035 is a humanized antibody against unique ENO1 target. This therapeutic antibody is first-in-class with macrophage-targeting features and showed efficacy in animal model for MS, IPF, and IBD. It also showed efficacy in animal model for liver cancer, pancreatic cancer, and lung cancer. GEM035 has a worldwide patent protection. US IND of GEM035 is approved and active now for treating MS.
03/11/20	GEM164	Anthracycline topoisomerase II inhibitor	Breast cancer, Bladder cancer, Kaposi's sarcoma, lymphoma, and Acute lymphocytic leukemia	i.v.	Small molecule	Oncology: Hematological cancer Oncology: Solid cancer	Bioequivalence study completed	Generic pegylated liposomal doxorubicin hydrochloride. Doxorubicin is well known to cause cardiotoxicity and develop congestive heart failure. Cardiotoxicity of GEM164 is expected to be substantially lower than non-liposomal doxorubicin. Bioequivalence with CAELYX has been demonstrated.

Drug Candidates

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Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
03/02/20	GEM163	Reduction of virus-replication and reduction of inflammation	Virus diseases (incl. coronaviruses)**	Oral	Oligo-saccharides	Infection	NDIN** ready	A novel, intestinally absorbable derivative (pat. pend.) of GRAS αCD (α-cyclodextrin) to reduce virus entry (endocytosis) and replication/assembly of virueses (availability of lyso-phospholipids). βCDs have been effective in vitro against many virus infections, incl. coronaviruses, and topically against influenza and HSV2. αCDs avoid the ototoxicity of βCDs and were more effective (tested in HIV-1 cells). **New dietary ingredient notification as a nutritional supplement/FSMP
03/02/20	GEM162	Restoration of autophagy and reduction of inflammation	Age-related diseases**	Oral	Oligo-saccharides	Others	NDIN** ready	A novel, intestinally absorbable derivative (pat. pend.) of GRAS αCD (α-cyclodextrin) as an intermittent fasting mimetic. βCDs have been effective in vivo against many age-related diseases, including cancer, AD, and PD. αCDs are more effective against endocytosis than β CDs and lack the βCDs' ototoxicity. In the EU, oral αCD may claim to "reduce post-prandial glycemic response", but has low and variable bioavailability. **New dietary ingredient notification as a nutritional supplement/FSMP
03/02/20	GEM161	Restoration of autophagy and reduction of inflammation	Cardiovascular and Metabolic Diseases	Oral	Oligo-saccharides	Cardiology Metabolic disease	Phase 2b/3 ready	A novel derivative (pat. pend.) of hydroxypropyl-α-cyclodextrin (HPαCD) that down-regulates the PI-system by controlling serum phospholipids and, thereby, reduces endocytosis. βCDs have been shown to be effective in vivo against atherosclerosis (AS), NAFLD, but can cause permanent hearing loss (not applicable to αCDs). Oral αCD is clinically effective against metabolic syndrom, but has low and variable bioavailability. 505(b)(2) is applicable.
03/02/20	GEM160	Restoration of autophagy and reduction of inflammation	Neuro-degenerative diseases	Oral, Intra-thecal	Oligo-saccharides	CNS	Phase 2b/3 ready	A novel derivative (pat. pend.) of hydroxypropyl-α-cyclodextrin (HPαCD) that down-regulates serum phospholipids and prevents aging cells from accumulating Aβ/tau (AD), α-syn (PD), myelin (MS), mHTT (HD), SOD1 (ALS), ... βCDs were effective in vivo against AD and PD, but development was abandoned (except for NPC) due to the risk of permanent hearing loss (not applicable to αCDs). In the US, αCD is generaly recognized as safe (GRAS) for oral use; in the EU, αCDs are approved for oral and parenteral use. 505(b)(2) is applicable.
03/02/20	GEM159	Restoration of autophagy and reduction of inflammation	Breast cancer and other carcinomas*	Oral, intra-venous	Oligo-saccharides	Oncology: Solid cancer	Phase 2b/3 ready	A novel intestinally absolrbable derivative (pat. pend.) of hydroxypropyl-α-cyclodextrin (HPα CD) that down-regulates the Phosphoinositide-system by controlling serum phospholipids and, thereby, reduces endocytosis. βCDs were effective in vivo against breast, ovarian, lung, and colon cancer, and metastatic melanoma, but need to be infused overnight and can cause permanent hearing loss. αCDs are not ototoxic and were more effective in vivo against growth and metastases of breast cancer. *Mono- or adjuvant treatment. 505(b)(2) is applicable.
02/27/20	GEM158	Anti-mitotic chemotherapy	Small cell lung cancer	i.v.	Small molecule	Oncology: Solid cancer	Phase 1 completed	Proprietary innovative albumin-stabilized pegylated liposomal docetaxel formulation. Elevated exposures of docetaxel compared with free (nonencapsulated) docetaxel were confirmed in animals and humans. Acceptable tolerability and results suggesting anti-tumor efficacy were observed in Phase 1. FDA orphan drug designation was granted and confirmed with FDA that 505(b)(2) NDA pathway appears to be an acceptable approach.
02/21/20	GEM157	Combined adoptive cell therapy (autologous)	Hepatocellular carcinoma (HCC)*	Infusion	Cell therapy	Oncology: Solid cancer	Launch	A combined adoptive cell therapy comprising cytokine-induced killer cells and activated cytotoxic T lymphocytes. In Phase III using patients whose tumors have been removed after curative resection for HCC, RFS was 44 months for the immunotherapy group while that of the control group was 30 months. The HR for tumor recurrence or death in the immunotherapy group vs the control group was 0.63. The mortality rate was reduced by 79% in the immunotherapy group vs the control group. Clinical trials for other solid tumors are ongoing. *: Adjuvant therapy for patients whose tumors have been removed after curative resection for HCC.

Drug Candidates

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Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
02/18/20	GEM156	Chromatin destabilizing	Solid and hematological tumors	Oral, i.v., i.a	Small molecule	Oncology: Hematological cancer Oncology: Solid cancer	Phase 1	A First-In-Class chromatin destabilizing agent that intercalates into DNA, and interferes with histone/DNA binding changing its spatial structure. Consequent functional inactivation of a histone chaperon FACT leads to inhibition of several previously undruggable pro-cancer transcriptional factors, activation of p53 and interferon response. Dose-dependent nonclinical antitumor activity is seen in multiple models of solid and hematological tumors. Oral and i.v. phase 1 studies demonstrated a manageable safety profile and disease control with tumor regressions and protracted stable disease.
02/03/21	GEM155	FPR2-specific ligand	Atopic dermatitis/Psoriasis, Dry eye disease, IBD (Inflammatory bowel disease), Asthma, Rheumatoid arthritis	Topical, Eye drop, s.c.	Peptide	Dermatosis Immunology/ Inflamation Ophthalmology Rheumatology	Phase 1	GEM155 is a small (7mer) lipidated peptide ligand for pro-resolving receptor FPR2 (N-formyl peptide receptor 2) involved in regulation of innate immune system and inhibition of ILC2 function (adaptive immune system). It also has anti-microbial effect for pathogenic bacteria through fusion with functional moiety. Efficacy is seen in animal models for the indications. CMC study is almost done. Toxicity study for topical usage and subcutaneous injection is going-on. Formulation for topical use is almost finished.
02/18/20	GEM154	Collagen-inducing peptide	Dermal filler, Cosmetics	Topical	Peptide	Dermatosis Others	Preclinical	Laminin-derived peptide. Boosts collagen synthesis at sub-nanomolar concentration (Wrinkle-care) & inhibits melanin synthesis (Whitening). Registered cosmetic ingredient.
02/18/20	GEM153	Angiogenic peptide	Wound-care, Diabetic foot ulcer, Cosmetics	Topical	Peptide	Dermatosis Metabolic disease Others	Preclinical	Increases blood vessel formation (VEGFA/VEGFR1 expression ↑& cell proliferation/migration ↑). Boosts collagen synthesis at sub-nanomolar concentration (Wrinkle-care) & inhibits melanin synthesis (Whitening). Registered cosmetic ingredient.
02/18/20	GEM152	Fat-adsorption inhibitor	Obesity, Diabetes, Fatty liver	Oral	Natural product	Metabolic disease	Preclinical	Mushroom-derived natural product. Reduces weight gain and obesity, blood glucose and lipid contents in the liver via reduction of lipid absorption in the gut.
02/18/20	GEM151	anti-GM-CSF monoclonal antibody	Rheumatoid arthritis & multiple new indications* (see note)	i.v.	Antibody	Immunology/ Inflammation Rare disease Rheumatology	Preclinical (ready for IND-enabling studies)	GM-CSF is a key player in inflammation and autoimmunity. GEM151 is a fully human monoclonal antibody generated by single B cell cloning and has superior affinity (Kd: 7.3 X 10 -11 M) compared to competitors. Neutralizing activities were confirmed by four different functional assays. *cytokine release syndrome., GvHD, multiple sclerosis/neuroinflammation, Kawasaki disease
02/12/20	GEM150	Melanocortin 4 & 5 agonist	Obesity	Oral	Peptide	Metabolic disease	Preclinical	A pro-drug of the cyclic peptide (BL3020-1) which is a melanocortin 4 & 5 agonist showing good permeability in the gut and BBB and great reduction in food consumption and body weight gain in mice. The pro-drug did not show aggregation which BL3020-1 did. Currently the pro-drug is being optimized.
01/29/20	GEM149	PKC modulator	Alzheimer disease	Oral, Intranasal	Small molecule	CNS	Phase 1	Up-regulates production of α-secretase which cleaves the amyloid precursor protein, APP, into a harmless soluble form, sAPP-α, which is non-neurotoxic and limits the formation of amyloid plaques.
01/29/20	GEM148	CCR5 inhibition	HIV	i.v.	Nucleic acid	Infection	Preclinical	GEM148 is a nanoencapsulation of proprietary, synthetic CCR5-siRNA targeted to knock-down and eliminate HIV-1 in chronic HIV patients as well as prevent HIV-1 infection in naïve patients and re-infection in acutely-infected patients.
01/29/20	GEM147	Insulin	Diabetes	Oral	Peptide	Metabolic disease	Preclinical	GEM147 is a nanoencapsulation of insulin in biodegradable polymer nanospheres. Nanoencapsulation protects insulin during stomach passage. In vivo, statistically significant reduction in blood glucose was seen in diabetic rats with oral GEM147 within 30 minutes.
01/29/20	GEM146	VD Receptor	Prostate cancer, Autoimmune diseases	i.v.	Small molecule	Immunology/ Inflammation Oncology: Solid cancer	Preclinical	GEM146 is a nanosomal formulation of a nontoxic Vitamin D3 analog. In vivo studies have shown strong anticancer effects of GEM146 against Hormone Refractory Prostate Cancer xenografts in nude mice at doses approximately 6.5 times less than the parent hormone, without significant toxicity.

Drug Candidates

GEMSEKI

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Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
01/29/20	GEM145	5-HT	Chemotherapy Induced Nausea and Vomiting (CINV)	Oral	Small molecule	Oncology: Supportive care	Phase 2/3	Acute vomiting was blocked effectively by 5-HT3 anti-emetics plus the adjuvant Emend® but no benefits were observed in terms of the incidence of nausea . Phase 2/3 clinical trial on GEM145 as an adjuvant to conventional 5-HT3 anti-emetics was completed (more than 600 cancer patients). All doses of GEM145 significantly reduced acute nausea severity compared to the placebo (p=0.003).
01/29/20	GEM144	PKC modulator plus HDAC inhibitor	HIV Latency	i.v., Oral	Small molecule	Infection	Phase 2a	GEM144 is a nanoencapsulation of PKC modulators plus HDAC inhibitor in targeted, pegylated phospholipid nanosomes for improved therapeutic index. Activates HIV from latent reservoirs so that HIV can be eradicated from the body by antiviral therapy and/or immune system.
01/29/20	GEM143	CB1, CB2, 5-HT1a	Multiple Sclerosis (MS), Opioid addiction, Chemotherapy induced Peripheral Neuropathic Pain (CIPNP), and Epilepsy	Oral	Small molecule	CNS Immunology/ Inflammation Oncology: Supportive care Pain/Neuropathy Rare disease	Preclinical	GEM143 is a nanoencapsulation of the API in biodegradable polymer nanospheres for improved oral bioavailability. MS: The API has multiple actions on key molecular neuroinflammation and neurodegeneration targets, with highly effective in vitro and in vivo bioactivities. Opioid addiction: The API is not an opioid and has been shown to alleviate cue-induced opioid addiction behaviors and allosterically modulate the μ and δ-opioid receptors. CIPNP: Nanoencapsulation is being used to protect the API during the stomach passage. Epilepsy: The API is an effective anti-convulsant with a specificity more comparable to drugs clinically effective in major seizures.
01/16/20	GEM141	Esophageal implant (See note)	Pediatric esophageal atresia and other conditions that affect the esophagus	Implant (autologous)	Cell therapy	Gastroenterology Regenerative medicine	IND ready	Esophageal implant made by combining a novel cell therapy platform (see TGEM38) with a patient's own cells (haematopoietic stem and precursor cells). GEM141 leverages the body's inherent capacity to heal itself as it is a "living tube" that facilitates regeneration of esophageal tissue and triggers a positive host response resulting in a tissue-engineered neo-conduit that restores continuity of the esophagus. These implants have the potential to dramatically improve the quality of life for children and adults
01/08/20	GEM140	Limbal stem cells	Intractable limbal stem cell deficiency	Implantation	Cell therapy	Ophthamology	Clinical	Establishment and production of limbus-derived epithelial cell plate manufacturing process in GMP facility with excellent economic feasibility. Phase 1 study is currently in progress.
01/08/20	GEM139	*Staphylococcus aureus* vaccine	*Staphylococcus aureus* infection	s.c.	Vaccine	Infection Vaccine	Preclinical	The vaccine comprising antigens and toxin is being developed. The candidate antigens to block the immune-evasion pathway by MSCRAMMs and toxin of S.aureus have already been defined
12/24/19	GEM138	Biosimilar adalimumab	Same indications as adalimumab	i.v.	Antibody	Dermatosis Gastroenterology Immunology/ Inflammation Ophthamology Rheumatology	Preclinical	Purified GEM138 is highly similar to adalimumab by SDS-PAGE. GEM138 and adalimumab show a similar response in a TNF-a ELISA assay. Plant-based technology (TGEM036) was applied for production of GEM138.
12/24/19	GEM137	Biosimilar ranibizumab	Same indications as ranibizumab	Intra-vetreal	Antibody	Ophthamology	Preclinical	Peptide mapping by Mass Spectrometry confirms amino acid sequence identity of GEM137 with ranibizumab. Purified GEM137 is highly similar to ranibizumab by SDS-PAGE. Ligand (rVEGF) biding by GEM137 demonstrated to be similar to ranibizumab by ELISA. Plant-based technology (TGEM036) was applied for production of GEM137.
12/24/19	GEM136	Biosimilar trastuzumab	Same indications as trastuzumab	i.v.	Antibody	Oncology: Solid cancer	Preclinical	GEM136 N-terminal sequences are identical to trastuzumab. Levels of contaminating proteins, profiles of breakdown products and inhibitory activity to trastuzumab on in vitro growth of hER2 positive breast cancer cell line are similar between GEM136 and trastuzumab. Plant-based technology (TGEM036) was applied for production of GEM136.

Drug Candidates

GEMSEKI

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
12/20/19	GEM135	Inhibition of proteasome via novel target	Multiple tumors	i.v., i.p. and Oral	Small molecule	Oncology: Hematological cancer Oncology: Solid cancer	Preclinical	Novel target different from that for all the commercially available proteasome inhibitors. Works against many cancer cell lines tested including bortezomib, cisplatin and paclitaxel resistant cell lines. Significant therapeutic window between cancer and normal cells. Favorable toxicity profile. Regressed tumor growth and prolonged survival on syngeneic and xenograft mouse models. Expected to be effective against solid tumors without off target effects and peripheral neuropathy. Two lead compounds are being developed.
12/06/19	GEM134	Anti-CD147 antibody	Hematological (AML, MM etc) and solid tumors (liver, colon, lung etc)	i.v.	Antibody	Oncology: Hematological cancer Oncology: Solid cancer	Preclinical	Fully human antibody binding to human/ cynomolgus CD147. Has been shown to be very effective in various types of cancers in vivo xenograft mouse model. ADCC activity mainly contributes to the anti-tumor effect.
11/29/19	GEM058	Increase cellular ATP and promote wound healing	Diabetes foot ulcer	Topical	Small molecule	Dermatosis Metabolic disease	Phase 2 completed	Reducing inflammation of endothelial cells of blood vessels. Increasing cellular ATP and speeding up the healing of wounds by promoting the migration of epithelia cells in the skin of wounds. The arrangement of actin which is essential for cell migration is ATP dependent. Applicable to all kind of wound and low cost treatment
11/25/19	GEM133	Myocardial protection by cardiac arrest temporally	Open heart surgery	Intra-coronary infusion	Others	Cardiology	Launched	GEM133 is a novel warm cardioplegic solution which in mixture with patient's oxygenated blood can produce effective and sustained cardiac arrest by a single dose 400ml. In addition, it has the following advantages; virtually unlimited aortic cross-clamp time, unassisted resumption of the cardiac rhythm, no ischemic and /or reperfusion injury, no need for cardiotonic support in the immediate postopertaive period.
11/15/19	GEM132	Matrix metalloproteinase-13 (MMP-13) inhibitor	Osteoarthritis (OA)	Intraarticular or Oral	Small molecule	Orthopedic	Preclinical	Extremely potent non-hydroxamic acid containing, non-zinc binding inhibitors of MMP-13 have been identified. High selectivity has been shown for this class of inhibitors over other MMPs. Lead inhibitor tested in the monoiodoacetate (MIA) rat model of OA and shown to protect cartilage when injected into the joint. Exhibits good oral bioavailability in the rat.
11/15/19	GEM131	Matrix metalloproteinase-2 (MMP-2) and MMP-9 inhibitor	Neuropathic pain and Amyotrophic Lateral Sclerosis (ALS)	Oral	Small molecule	CNS Pain/Neuropathy Rare disease	Close to IND ready *	Pain: GEM131 can block inflammatory responses at the site of nerve damage and has been shown to be efficacious in 4 different rodent models of neuropathic pain (spinal nerve ligation, chronic constriction injury of the infraorbital nerve, morphine withdrawal and thermal injury). ALS: Elevated levels of MMP-2 and-9 have been found in the skin and blood of people with ALS. Significantly improved larval locomotion in both the TDP-43 and SOD1 larvae models in Drosophila. Exhibits good oral bioavailability. *: Final stages of completion of IND enabling studies for both neuropathic pain & ALS
11/15/19	GEM130	Antiviral	Infections caused by herpes simplex virus in face and lip	Topical	Small molecule	Dermatosis Infection	Launched	• First cold sore product on the market that combines the therapeutic benefits of an antiviral with an innovative transparent bioadhesive film. • When applied to the lesion, generates a transparent film that acts as a bioadhesive sustained matrix release that improves product bioavailability while promotes itching reduction and wound healing. • Indicated for the topical treatment of symptoms (tingling, burning, discomfort) of recurrent herpes labialis caused by herpes simplex virus (VHS).
11/15/19	GEM129	Immuno-modulator	Anogenital warts, Actinic keratosis, Basal cell carcinoma	Topical	Small molecule	Dermatosis Infection Oncology: Solid cancer Urology	Phase 2	• The first product on the market that combines the therapeutic benefits of a marketed immunomodulator with an innovative transparent bioadhesive film. • When applied to the lesion, generates a transparent bioadhesive film, which acts as a reservoir or matrix release and reduces the local reactions and increases the permanence of the product in the action site. • The results of non-clinical studies demonstrate that GEM129 has a better safety profile with an equivalent efficacy than its reference product. Clinical studies on-going.

Drug Candidates

GEMSEKI

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
11/15/19	GEM128	Antibiotic	Primary and secondary skin infection - canine pyoderma	Topical	Small molecule	Others	Clinical for animal	• The first medicine on the market that combines the therapeutic benefits of a marketed antibiotic with an innovative film-forming, long-lasting delivery technology. • When applied to the lesion, generates a transparent film that acts as a bioadhesive sustained release matrix maintaining the optimum concentration of the antibiotic in the skin for a period of 6-8 hours. • The bioadhesive film generated reduces product removal from the area due to animal scratching, licking or friction with skin folds which contribute in improving the treatment efficacy. Also, reduces oral antibiotic overusing by improving topical treatment with this innovative technology. *Canine bacterial infections of the skin, including superficial pyoderma
11/15/19	GEM127	Antibiotic	Primary and secondary skin infection - Impetigo, folliculitis, furunculosis (human use)	Topical	Small molecule	Dermatosis Immunology/ Inflammation Infection	Launched	• The first product on the market that combines the therapeutic benefits of a marketed antibiotic with an innovative transparent film-forming and bioadhesive delivery technology. • When applied to the lesion, generates a film that acts as a bioadhesive sustained release matrix, maintaining the optimum concentration of antibiotic in the skin for a period of 6-8 hours. • The bioadhesive film generated prevents the removal of the antibiotic from the lesion and acts as a protective dressing that prevents infection spreading
11/5/19	GEM126	Selective estrogen receptor downregulator	ER+ advanced or metastatic breast cancer	Oral	Small molecule	Oncology: Solid cancer	Phase 1	• Both antagonizes and degrades ER alpha in cells to achieve the goal of blocking the estrogen signaling pathway. • Favorable oral pharmacokinetics in healthy rats and dogs whereas fulvestrant has a low bioavailability and can only be intramuscularly administrated. • Favorable preclinical in vitro and vivo single agent efficacy in inhibiting ER+ breast cancer cell proliferation, in models of tamoxifen-sensitive and tamoxifen-resistant breast cancer. • Highly selective, no effect on other kinases and receptors. • Can be licensed to global area with some linitation.
11/5/19	GEM124	Improves endothelial cell function and cellular fluidity. Antiatherosclerotic, antiinflammatory, anti-fibrotic, fat-targeting composition	1) Atherosclerosis (#) 2) Treatment of NASH (Stage F2-F3) Fibrosis with no worsening of fibrosis.	Oral	Small molecule	Cardiology Immunology/ Inflammation Metabolic disease	Preclinical	1) Developed to target vulnerable, high risk plaques while also reducing LDL cholesterol, increasing HDL cholesterol and reducing Triglycerides. (#) Future indications: primary prevention of Heart Attack, Stroke and Death and Secondary Prevention of Myocardial Infarction in Europe. US Patent to treat Atheroslersis is valid until 2035. 2) Concurrently being developed to treat liver inflammation, fibrosis and fat accumulation while also reducing LDL cholestrol and Triglycerides. *May be used in combination with other drugs, such as Intercept's Ocaliva that increases Triglycerides or Gilead's NASH candidate that increses LDL cholesterol.
10/29/19	GEM123	miRNA targeting cancer stem cells	Colon cancer	i.v.	Nucleic acid	Oncology: Solid cancer	Preclinical	GEM123 suppressed the stemness of cancer cells by inhibiting KLF5 expression, and provoked apoptosis and cycle arrest through the downregulation of TFDP1and MDM2 expressions. GEM123 also inhibited tumor growth with no apparent side effect in mouse model.
10/29/19	GEM122	Natural Killer T (NKT) cell-mediated anti-tumor responses	Solid cancer	i.v.	Cell therapy	Oncology: Solid cancer	Phase 1	GEM122 shows its anti-tumor activity by activating endogenous NKT cells. Activated NKT cells strongly enhance both innate and acquired immune systems, induce the long-term immune memory and promote accumulation of TILs (tumor infiltrating lymphocytes) in tumor sites. GEM122 consists of a novel NKT ligand and a novel APC. The novel NKT ligand shows much stronger NKT activity than the previous NKT ligand, α-Galactosylceramide and by using the novel APC, the cellular product can be manufactured efficiently as well.
10/23/19	GEM121	Modified phytic acid	Cancer	Oral	Small molecule	Oncology: Hematological cancer	Preclinical	• Demonstrated selective anti-cancer effects including apoptosis and inhibition of Akt activation. • In vivo study using mice with adult T-cell leukemia showed reduction of the size of the
10/23/19	GEM120	Inhibition of membrane binding of Pr55Gag	HIV	i.v.	Small molecule	Infection	Preclinical	• Inhibited the membrane localization of Pr55Gag and stopped budding of HIV virus. • Captures HIV in immune cells and induces apoptosis of the HIV-infected immune cells.

Drug Candidates

GEMSEKI

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
10/23/19	GEM119	Inactivation of end-product of lipid peroxidation	Cerebral Infarction	i.v.	Small molecule	CNS	Preclinical	• Showed more potent 4-hydroxynonenal - quenching activity compared with carnosine or histidine hydrazide (HH) at 30min incubation. • GEM119 (ip administration) rescued the hippocampal CA1 cell death of transient cerebral ischemia model of Mongolian gerbil whereas HH did not.
10/23/19	GEM118	Suppression of TGF-β/Smad and related signaling	Systemic sclerosis	Oral	Small molecule	Dermatosis Rare disease	Preclinical	• Inhibited phosphorylation of Smad3 and expression of Col1a2, FN1 and CTGF stimulated by TGF-β in cultured human dermal fibroblasts. • Ameliorated bleomycin-induced skin fibrosis in both preventative and curative mouse model.
3/26/21	GEM117	Induction of apoptosis in adipocyte	Liposysis, Non-surgical fat reduction, Diabesity	s.c.	Small molecule	Metabolic disease	Phase 2a Completed	• GEM117 specifically induce apoptosis on local injection site adipocyte • Phase 1 showed great safety without drug related SAE in 40 healthy volunteers • In the Phase 2a study (n=39), GEM117 showed significant dose dependent lipolysis effects and reduced an average of 24% local fat volume. Safety profile was similar as observed in Phase 1 study.
10/16/19	GEM116	Increase in lipolysis, fat and energy metabolism	Obesity, Diabesity, NAFLD/NASH	Oral	Small molecule	Metabolic disease	Phase-2 (POC) Completed	• GEM116 demostrated the saftest profile in its clinical phase 2 study with more than 200 patients without any drug related AE or SAE and potentially lower CVD risk seen by other competitors in the market. • Around 30% of subjects lost at least 5% body weight in 12 weeks, GEM116 shows around 5% body fat lost, lower TC by around 12mg/dL, and lower LDL by around 6 mg/dL •Pre-clinical study shows GEM116 has the potential to treat NAFLD/NASH via reducing liver fibrosis by aroud 40% .
10/16/19	GEM115	Trastuzumab biosimilar-ADC	HER2-positive metastatic breast cancer	i.v.	Antibody	Oncology: Solid cancer	Phase 1	Conjugate of trastuzumab biosimilar and DM-1. The profiles of trastuzumab of GEM115 and GEM115 are similar to Herceptin and Kadcyla, respectively, in peptide mapping, receptor binding affinity, inhibition of cell proliferation, ADCC activities, in vivo xenograft mouse model, PK etc. Potential Indication: Early Breast Cancer (adjuvant)
10/16/19	GEM114	Ophthalmic formulation of GEM113	Wet AMD	Intra-vetreal	Antibody	Ophthamology	Phase 1	GEM114 mainly distributed in retina, vitreous body and aqueous humor after intravetreal injection in animals. Potential Indication: Diabetic Macular Edema; Myopic Choroidal Neovascularization (mCNV); Retinal Vein Occlusion (RVO); Diabetic Retinopathy (DR)
10/16/19	GEM113	Bevacizumab biosimilar	Non-Squamous NSCLC	i.v.	Antibody	Oncology: Solid cancer	Phase 3	The profile of GEM113 is similar to Avastin, in peptide mapping, receptor binding affinity, inhibition of cell proliferation, in vivo xenograft mouse model, PK etc. Potential Indication: Metastatic Coloerectal Cancer; Recurrent Giloblastoma; Metastatic Renal Cell Carcinoma; Persistent Recurrent or Metastatic Cervical Cancer; Epithelial Ovarian, Fallopian Tube, or Primary Peritoneal Cancer
10/4/19	GEM112	Antibody against *H.pylori* - derived HSP60	Eradication of *H.pylori*	i.v.	Protein	Gastroenterology Infection	Preclinical	Antibiotic-resistance *H.pylori* are getting serious and antibiotic therapy failure rate is over 20%. GEM112 is a highly specific antibody against H.Pylori-derived HSP60 which inhibits T cell proliferation and induces IL-10 and TGF-b1. GEM112 does not bind to human HSP60.
10/4/19	GEM065	Fucosylation of CAR-T cell and TCR-T cells to improve homing to tumors, increased intra-tumor penetration and killing of cancer cells. Potential for enabling CAR-T cell therapies to achieve higher response rates for treatment of blood cancers and also work for treatment of solid tumors	Lymphoma, Leukemia, Melanoma, Lung and breast cancers are initial indications	Infusion	Protein	Oncology: Hematological cancer Oncology: Solid cancer	Preclinical; Human safety and efficacy observed in stem cell transplantation	Ex-vivo fucosylation kit using proprietary recombinant fucosyl-transferase enzymes aimed at improving efficacy, safety and cost of care for T-cell therapy not only for treatment of blood cancers but also importantly, enabling CAR-T cell therapy to work in the treatment of solid tumors . Similar technology as in GEM036 for hematopoietic stem cell therapy, but a different fucosyl-transferase is used. Fucosylation enhances homing and intra-tumor penetration of CAR-T, TCR-T, TIL/CTL cells for improved tumor killing. Fucosylation does not affect healthy tissues.

Drug Candidates

GEMSEKI

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
9/30/19	GEM111	c-RAF allosteric inhibitor	Multiple cancers (lung, renal, liver etc)	Oral	Small molecule	Oncology: Solid cancer	Phase 2 ready	A second generation (novel salt) of the c-RAF allosteric inhibitor in GEM 110 allowing for a more patient-centric dose profile. The clinical safety profile of GEM110 thus far will be informative and additive to the current clinical program thereby significantly de-risk and accelerate the clinical stage development of GEM111.
9/30/19	GEM110	c-RAF allosteric inhibitor	Multiple cancers (lung, renal, liver etc)	Oral	Small molecule	Oncology: Solid cancer	Phase 1	The product is the combination of GEM110 and sorafenib. The product induces pDAPK and c-Raf to transfer from mitochondria to cytoplasm together with ROS increment resulting tumor cell death and demonstrated 73% and 57% tumor inhibition rate respectively in lung cancer and renal cancer animal xenograft model. FDA approved the clinical protocol to explore subjects by p-DAPK biomarker whose expressin could be related with tumor progression.
9/30/19	GEM108	Buccal Epithelial cells for re-epithelization	Urethral strictures	Implantation	Cell therapy	Regenerative medicine Urology	Phase 2b completed	Live cultured buccal epitherial cells indicated for urethral strictures. Excellent safety and efficacy profiles have been established through Phase IIb clinical trials. Potential label extension to rare disease in pediatric population; hypospadias.
9/30/19	GEM107	Chondrocytes for hyaline cartialge regeneration.	Articular cartilage defects	Interventional Implantation	Cell therapy	Orthopedic Regenerative medicine	Launch	Live cultured chondrocytes indicated for hyaline cartilage reneration in cartilage injuries. Over 600 pateints treated with several publications and patent protection.
9/30/19	GEM106	Osteoblasts for bone regeneration	Avascular necrosis/ Osteonecrosis	Interventional Implantation	Cell therapy	Orthopedic Rare disease Regenerative medicine	Launch	Live cultured osteoblasts indicated for bone repair and regeneration that stop progression of avascular necrosis. Over 400 pateints treated with GEM106. Potential label extension to different indications. This product has been granted Orphan Designation by the US FDA & EMA
01/29/21	GEM105	Viscosupplementation	Knee osteoarthritis	Intraarticular	Poly-saccharide	Orthopedic	Marketing authorization	Cross-linked sodium hyaluronate hydrogel with sodium hyaluronate fluid. Long-lasting and sustainable efficacy due to unique rheology of the cross-linked hydrogel. Injected only once and single injection shows comparable efficacy to a multiple-injection treatment. Obtained marketing authorization as a drug.
09/12/19	GEM104	Interleukin-1 beta inhibition	Various types of colitis (IBD, immune-related and chemotherapy-induced colitis)	Oral	Small molecule	Gastroenterology	Preclinical	-A known approved drug molecule developed for new therapeutic indications of treating and alleviating symptoms of various types of colitis. -Showed greater pharmacological effects than the reference drug, mesalazine, in reducing inflammatory colon swelling and intestinal ulceration, while restoring damaged intestinal membrane. -One of few products capable of repairing damaged intestine membrane caused by colitis. -Synergistic effect via different mechanism of actions, can provide greater medical benefits to patients suffering from IBD or various types of colitis caused by cancer treatment with chemo- or immuno-therapy.
08/21/19	GEM102	Cyclodextrin derivative	Cancer	i.v.	Small molecule	Oncology: Solid cancer	Preclinical	Modified Methyl-b-Cyclodextrin (CyD). Displayed potent antitumor activity in vitro, compared to M-β-CyD. Drastically inhibited tumor growth after a single intravenous injection to tumor-bearing mice, compared to doxorubicin and M-β-CyD, without any significant change in blood chemistry values
08/16/19	GEM101	GABA-A negative allosteric modulator and an inhibitor of α2 δ subunit of voltage-gated calcium channels	Depression and PTSD	Intra-nasal	Peptide	CNS	Preclinical	Exhibited both rapid and long-lasting anxiolytic and antidepressant activity in vivo animal models. Stable in vivo and crosses the blood-brain barrier. No adverse effects typical for standard of care drugs (No sedation, No tolerance, No cognitive impairment, No addiction potential)
08/16/19	GEM100	mGluR5 negative allosteric modulator	Depression and movement disorder	Intra-nasal	Peptide	CNS	Preclinical	mGLuR5 leader peptide was discovered and in vivo efficacy confirmed. GEM100 specifically increases locomotor activity in rats, with no effects on behavior.
08/13/19	GEM098	GnRH receptor antagonist	Endometriosis and Uterine fibroids	Oral	Small molecule	Endocrinology Gynecology	Phase 1	In Phase 1b, GEM098 showed dose-dependent suppression of LH, FSH and E2. The suppressive effects on E2 lasted up to 24 hrs and were more excellent when compared with the published phase 1 data of Elagolix in healthy premenopausal women. No serious adverse events were seen and well tolerated up to 320 mg QD.

Drug Candidates

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
08/13/19	GEM097	Factor VIIa derivative	Bypassing therapy in hemophilia with inhibitors	i.v.	Protein	Hematology	IND ready	GEM097 is rFVIIa fused to transferrin and has longer half-lives than rFVIIa in rats and monkeys. A cleavable linker between rFVIIa and trasferrin of GEM097 allows minimal reducuction of FVIIa activity due to fusion. Preclinical (GLP) toxicity studies did not show any toxic evidence in rats or monkeys.
07/31/19	GEM096	Progesterone receptor agonist	Recurrent preterm birth	Oral	Small molecule	Endocrinology Gynecology Rare disease	Phase 2 completed	Potentially the first oral hydroxyprogesterone caproate product candidate indicated for the prevention of recurrent preterm birth and has been granted orphan drug designation by the FDA. An end of Phase 2 meeting was completed with the FDA.
07/31/19	GEM095	Androgen receptor agonist	NASH, Cirrhosis	Oral	Small molecule	Metabolic disease	Phase 1	An oral prodrug of bioidentical testosterone that is being developed as a treatment of cirrhotic non-alcoholic steatohepatitis (NASH).
07/31/19	GEM094	Androgen receptor agonist	NASH, Pre-Cirrhosis	Oral	Small molecule	Metabolic disease	Phase 2 ongoing	An oral prodrug of bioidentical testosterone that is being developed as a treatment of non-alcoholic steatohepatitis (NASH) and is being studied in the LifT Phase 2 clinical study in biopsy confirmed NASH subjects.
07/31/19	GEM093	Androgen receptor agonist	Hypogonadism	Oral (QD)	Small molecule	Endocrinology Urology	Phase 2 completed	A novel next generation oral prodrug of testosterone with potential for once-daily oral dosing that has completed Phase 2 testing.
12/21/20	GEM092	Androgen receptor agonist	Hypogonadism	Oral (BID)	Small molecule	Endocrinology Urology	Received FDA tentative approval	A novel oral prodrug of testosterone that is designed to help restore normal testosterone levels in hypogonadal men. GEM092 was well tolerated and met the primary end-points in Phase 3 testing with twice daily dosing. Easy to use for patients and physicians to prescribe due to fixed doing regimen.
07/16/19	GEM091	Prevention of protein aggregation via increased intracellular ATP and increase of expression of tyrosine hydroxylase (TH)	Parkinson's disease	Oral Nasal	Small molecule	CNS	Preclinical	New treatment for Parkinson's disease. GEM091 increases intracellular ATP level and ATP is reported to boost protein solubility. GEM091 increases TH expression and dopamine production, reverses paraquat induced PD symptoms and improves behavior of 6-OHDA treated mice.
07/16/19	GEM090	Increase cellular ATP and promote wound healing	Epidermolysis bullosa (EB)	Topical	Small molecule	Dermatosis Rare disease	Preclinical	Increasing cellular ATP and speeding up the healing of wounds by promoting the migration of epithelia cells in the skin of wounds. Expected to shorten wound healing time and improve EB patients' QOL with a formulation optimized for EB treatment. Moreover, maybe reduces the risk of squamous cell carcinoma which is highly related to Dystrophic EB patients.
07/12/19	GEM089	Inhibition of pro-cytokines, enhancement of growth factor PDGF	Alzheimer's disease and Vascular dementia	Topical	Botanical	CNS	Phase 2	Small molecules from soybean extract. MOA is different from Tau and Amyloid mechanisms. Effective in $AlCl_3$ induced Alzheimer-like dementia model and bilateral common carotid artery occlusion induced vascular dementia model. In Phase 2 study, MMSE and ADAS-Cog for patients without any dementia medication indicated that 70-85% patients improved at weeks 4 and 12.
07/12/19	GEM088	SSRI with agonist-antagonistic action on 5-HT receptors	Urinary incontinence	Oral	Small molecule	Urology	Phase 3 ready	Repositioning from another indication and has already a proven record of good safety in more than 300 patients with further 300 treated in phase 2. It has shown therapeutic activity in animal models of both stress and urge urinary incontinence. In phase 2 trials, clinically meaningful effects in mixed incontinence were shown as well as very good tolerability. The compound is ready to enter phase 3.
07/08/19	GEM087	Corticosteroid receptor agonist	Ocular inflammation and Meibomian gland dysfunction (MGD)	Topical (eye drop)	Small molecule	Ophthamology	Preclinical	New ophthalmic suspension of loteprednol etabonate (LE) with improved ocular bioavailability. - Drug exposure in aqueous humor and iris ciliary body are about 6 fold higher than Lotemax ® in rabbits. - The new formulation of LE administered twice a day for the treatment of adjuvant induced chronic uveitis model in rabbits showed a similar efficacy with lotemax administered four times a day

Drug Candidates

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
07/08/19	GEM086	VEGF inhibitor	Wet AMD (age-related macular degeneration)	Topical (eye drop)	Small molecule	Ophthamology	Preclinical	New formulation of axitinib designed to deliver the drug across ocular tissues to choroid and retina. - Greatly enhancing aqueous solubility (4000-fold solubility enhancement) - High drug exposure in retina (300-fold of IC50) - Potential for substitution of anti-VEGF Ab treatment via intravitreal injection
07/08/19	GEM085	Cancers with moderate to high Her2 expression	Cancers with moderate to high Her2 expression	i.v.	Protein	Oncology: Solid cancer	Preclinical	The anti-Her2 ADCs consiting of trastuzumab and novel linker-drugs. - 10-100 fold higher potency comparting to Kadcyla® - High theraperutic window (MED ~1-2 mg/kg, MTD ~100 mg/kg in mice) - High tumor growth inhibition rate (90-100%) with high stability in vivo
07/04/19	GEM084	MRI contrast agent formulation	Diagnosis of bladder cancer	Topical (Intravesical)	Other	Diagnosis	Phase 2 ready	New formulation consisting of iron and gadolinium for intravesical instillation. A pilot trial in humans provided evidence that the MRI contrast agent can be detected in the bladder wall. No treatment-related AEs were observed.
07/04/19	GEM083	Vasoconstriction and anti-inflammatory action	Hemorrhagic cystitis	Topical (Intravesical)	Small molecule	Immunology/ Inflammation Oncology: Supportive care Rare disease Urology	Phase 2	Pre-liposomal lyophilate containing tacrolimus. POC achieved in animal models of both chemo-cystitis and radiation cystitis. POC achieved in first-in-man experience treating severe recurrent hemorrhagic cystitis. Orphan drug designation granted.
05/30/19	GEM078	Hyaluronic acid-based nanocarriers of cisplatin	Head and neck cancer, Pancreatic cancer, Melanoma with metastasis	i.v.	Small molecule	Oncology: Solid cancer	Preclinical	CD44 targeting and higher stability lead to enhance lymphatic delivery and inhibit cancer with lymphatic metastasis. Chemodrug encapsulated by nanocarriers minimize systemic toxicities. Convenient dosing by intravenous injection.
05/30/19	GEM077	AMPK activator	Topical fat accumulation	Transdermal or oral	Small molecule	Metabolic disease	Preclinical	A small molecular AMPK activator. It inhibited the growth of adipocytes in vitro and suppressed body weight and fat increases in vivo. Topical used formulation is under testing.
05/30/19	GEM076	Galectin-12 inhibitor	Seborrheic dermatitis; Sebaceous hyperplasia	Transdermal	siRNA	Dermatosis	Preclinical	A modified siRNA for suppressing gene expression of galectin-12 which is a lipid droplet protein and regulates lipid accumulation and lipolysis. The siRNA can reduce the lipid in sebocytes and adipocytes and shows good stability and selectivity to reduce the lipid accumulation through transdermal delivery in vivo.
05/30/19	GEM075	Novel functional excipient	Oral formulation (e.g. direct compression, granulation, solid dispersion)	Oral	Polymer	Others	Preclinical	The synthetic polyvinyl acetate (PVAc)-based polymer of functional excipient is utilized as solubilizer that could increase drug solubility and enhance drug absorption. This novel excipient has better flowability, easy for use and widely application. This excipient will be useful for new drug and insoluble drug development.
05/30/19	GEM074	Dual inhibitor of Topo 1 and Topo 2	Drug resistant cancers	i.v.	Small molecule	Oncology: Solid cancer	Phase 1	1st-in-class combo therapy, covalently conjugated to simultaneously inhibit Topo 1 and 2, w/ EGFR cross-talk and extremely low toxicity for high dosing. Reduced tumor sizes w/ 38% CR and 98% TGI (compared to 0% and 33%, respectively, for imatinib) in CML xenograft models; and 98% TGI in colon cancer models at low doses. Showed immunotherapy enhancement effects with anti-PD-1 Ab and anti-CTLA-4 Ab with 100% CR in ovarian cancer model. No toxicity in rat & monkey models; No SAEs reported in Phase I at high dose 180mg/m2. Excellent PK profile and GI permeability of 9.2 enabling oral formulation.
05/30/19	GEM073	Kinase inhibitor of TGFβ-mediated phospho-SMAD2 signal transduction	COPD, IPF, Lung cancer	Oral	Small molecule	Immunology/ Inflammation Oncology: Solid cancer Respiratory	Phase 1	This kinase is selectively expressed in resident macrophages and airways epithelia of the lung and upregulated in COPD and IPF patients. A highly selective inhibitor showed efficacy across at least 3 different animal models relevant to COPD, IPF and NSCLC. Phase 1 trial has completed with a clean safety and tolerability profile.

Drug Candidates

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
05/30/19	GEM072	Orally available somatostatin analogues	Metabolic syndromes, Acromegaly, Hyperprolactinemia etc.*	Oral	Protein	Endocrinology Gynecology Metabolic disease	Preclinical	The technology and "know-how" to synthesize somatostatin analogues which will be more potent, more specific, stable and orally available have been established. A few analogues (at lead generation/optimization stage) with different combination of receptor selectivity and differential hormonal secretion inhibition properties are available. *: Congenital hyperinsulinism, insulinomas, glucagonomas
04/02/19	GEM071	Nanoparticl formulation of 2-deoxy-glucose	Hepatocellular carcinoma, Renal cancer, Colorectal canser	i.v.	Small molecule	Oncology: Solid cancer	Preclinical	In the xenograft model, the administration of nanoparticle formulation once a week showed superior antitumor effect than daily administration of 2-deoxyglucose alone. No side effects were observed. Enhanced the antitumor effect by combination with existing anticancer drugs. Enhanced T cell infiltration into tumor tissue. The substrate used in the nanoparticle formulation are used in approved medicines (FDA).
04/02/19	GEM070	Nanoparticl formulation of γ-Oryzanol	Diabetes, Hyperlipidemia, Menopausal disorder, Irritable bowel syndrome, etc.	Oral	Small molecule	Endocrinology Gastroenterology Metabolic disease	Preclinical	Improved intestinal absorption and shows a drug effect in an extremely small amount (1/1000 of normal particles). Reduced preference for high fat diet. Suppressed ER stress enhancement on hypothalamic/pancreatic islet. Improved abnormal glucose metabolism and abnormal lipid metabolism. The substrate used in the nanoparticle formulation are used in approved medicines (FDA).
03/12/19	GEM024	1. Selective inducer of apoptosis through modulation of NF-kB/P53 axis. 2. Eliciting adaptive immune response by recruitment of T Cells to tumors.	Oral squamous cell carcinoma	Oral, pastille based topical delivery	Small molecule	Oncology: Solid cancer	Phase 2 ready	Updated on March 12, 2019 First-in-class, patented, combination therapeutic that simultaneously upregulates a cluster of genes promoting cell death and downregulates a cluster of genes promoting survival of cancer cells. Phase 1 results showed no significant AE, dose-dependent modulation of key biomarkers involved in disease pathogenesis, and T cell recruitment to tumor making it “hot”. FDA approved moving to Phase 2.
03/07/19	GEM069	Immuno-modulator (adjuvant)	Vaccine, Cancer immunotherapy etc.	Injection	Other	Immunology/ Inflammation Oncology: Solid cancer Vaccine	Preclinical	*E.coli* producing monophosphoryl Lipid A whose structure is similar to exsiting adjuvants such as MPL and GLA. Shows similar efficacy with MPL in vitro and in vivo. Lower cost production through simple fermetation and purification steps.
03/01/19	GEM068	Gene therapy for novel target	Lung and other cancers	i.v.	Nucleic acid	Oncology: Solid cancer	Preclinical	The expression of this gene is reduced in various cancers. Adenovirus expressing this gene inhibits the HIF-1α expression and proliferation of various cancer cells. Adenovirus expressing this gene suppresses growth of lung cancer in nude mice.
01/29/21	GEM067	c-Kit inhibitor	Diabetic macular edema & Retinopathy	Oral	Small molecule	Ophthamology	Phase 2a completed	Inhibits stem cell factor-induced hyperpermeability Reverses retinal vascular leakage in STZ-induced diabetic rats Improved compliance to administration (oral) than anti-VEGF therapy (intra-vitreal injection) Applicable to non-responders to anti-VEGF therapy Repositioning of a marketed drug
03/01/19	GEM066	Selective STAT3 inhibitor (DNA-based Decoy)	Head and neck squamous cell carcinoma and Non-small cell lung cancer (including exon 20 mutations)	i.v.	Nucleic acid	Oncology: Solid cancer	Pre-IND for systemic administration formulation	1st-in-class STAT3 decoy; Suppresses binding of STAT3 to genomic DNA; Inhibits proliferation and promotes apoptosis of many cancer cells; Suppresses expression of STAT3 target genes and tumor growth in animal models; Shows increased response in combination with cetuximab and also with PD-1; Human Phase 0 study (intratumor injection); Suppresses STAT3 target genes expression with one dose Does not affect normal oral keratinocytes; Exploratory animal toxicology studies show no significant adverse effects

Drug Candidates

GEMSEKI

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
02/12/19	GEM063	Novel 24hr ibuprofen patch	Local pain in sprains	Local	Small molecule	Orthopedic Pain/Neuropathy	Phase 1	High payload: Contains 200 mg ibuprofen, Constant delivery over 24 hours, Class-leading adhesion, Water-resistant, Comfortable to wear and remove Pre-clinical safety studies were completed 2017 with no concerns/issues Phase I PK and sensitisation/irritancy studies were successfully completed in 2018 with no concerns/issues
01/11/19	GEM009	BET inhibitor	Cancer, RA	Oral	Small molecule	Oncology: Solid cancer Rheumatology	Preclinical	Updated on January 11, 2019 More potent enzyme inhibition and anti-tumor activities compared with competitors (more potent than GSK525762A and comparble to ABBV-075). Superior safety profile than competitors (no inhibition on hERG or CYP3A4) and can be applied to RA. Easier manufacturing due to absence of asymmetric carbon.
01/11/19	GEM003	Selective glucocorticoid receptor agonist	RA/OA, Please refer to Note	Local	Small molecule	Dermatosis Gastroenterology Immunology/ Inflammation Orthopedic Respiratory Rheumatology	Preclinical	Updated on January 11, 2019 Expected to reduce unfavorable responses of glucocorticoids by selectivity of action (transrepression>transactivation) Discontinued development for RA/OA. Available for repositioning. Possible indications: Atopic dermatitis, Psoriasis, Asthma, COPD, Inflammatory bowel disease etc.
01/11/19	GEM002	Kappa-opioid receptor agonist	Pain/Itching, Please refer to Note	Oral	Small molecule	Gastroenterology Pain/Neuropathy	Preclinical	Updated on January 11, 2019 Discontinued development for pain because of company strategy. Available for repositioning. Possible indications: Chronic pains (Back pain, Arthritis pain, Cancer pain, Post-herpetic neuralgia, Trigeminal neuralgia etc), Pruritus, Irritable bowel syndrome
01/11/19	GEM001	TRPV-1 agonist	Rheumatoid Arthritis, Please refer to Note	Oral	Small molecule	Dermatosis Gastroenterology Hematology Infection Metabolic disease Oncology: Hematological cancer Oncology: Solid cancer Pain/Neuropathy Rheumatology	Phase 2a	Updated on January 11, 2019 Potently inhibits TNF-a production by oral administration. Discontinued development for RA. Available for repositioning. Possible indications: Neuropathic pain, Crohn's disease, Systemic lupus erythematosus, Cachexia, Acute infectious disease, Allergy, Pyrexia, Anemia, Diabetes, Diseases related TNF-α (Colitis, Psoriasis ets.)
12/21/20	GEM062	Anandamide(AEA)-releasing topical formulation (sustained release for about 24 hours)	Cutaneous Lupus, (and other autoimmune/ inflammatory skin conditions)	Topical	Small molecule	Dermatosis Immunology/Inflammation	Preclinical	Tissue imaging to demonstrate efficient penetration and controlled release of AEA from AEA-loaded GEM062. Efficacy of AEA-loaded GEM062 in treating cutaneous lesions in murine model of CLE has been demonstrated.
01/07/19	GEM061	Curcumin-releasing topical formulation (sustained release for about 24 hours)	Please refer to Note	Topical	Small molecule	Cardiology Hematology Immunology/ Inflammation Orthopedic	Preclinical	Indication: Osteoarthritis, CV disease, chronic inflammatory disease, vascular disease (Sickle Cell) Note: Curcumin's utility: chronic pain, chronic inflammatory conditions such as osteoarthritis, vascular disease such as Sickle Cell and diabetes. This formulation addresses limitations of the poor oral bioavailability of curcumin. Preclinical efficacy demonstrated in an rodent arthritis model and a rodent diabetes model.

Drug Candidates

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
01/07/19	GEM060	Nitric Oxide-releasing topical formulation (sustained release for over 48 hours)	Please refer to Note	Topical	Small molecule	Dermatosis Urology Otolaryngology	Preclinical	Indication: Acne, Atopic Dermatitis, Fungal diseases, Wound healing, Chronic rhinosinusitis, Diabetic foot ulcers, Raynaud's Phenomenon, Middle-ear infections, Erectile dysfunction, Others Note: NO function: Regulation of the vasculature (vasodilatory), broad spectrum antimicrobial activity, anti-inflammatory, anti-oxidant, wound healing, skin cell maturation and survival etc. Human POC already shown with NO in onychomycosis, genital warts, moscullum contagiosum, pulmonary hypertension, acne, atopic dermatits (preliminary); animal POC demonstrated in over 20 peer-reviewed papers. Efficacy also demonstrated in preclinical model of erectile dysfunction. This formulation addresses many limitations of NO by providing cost-effective, shelf-stable formulation that provides sustained release of NO.
12/27/18	GEM059	Recombinant Human Interleukin-1 Receptor Antagonist	Please refer to Note	IM	Protein	Gastroenterology Immunology/ Inflammation Infection Oncology: Supportive care Orthopedic	Phase 1	Indication: 1: Infection, as manifested by febrile neutropenia, in patients with malignancies receiving chemotherapy drugs. 2: Diarrhea in patients with malignancies receiving chemotherapy drugs. 3. Gout arthritis Note: The world's first multiorgan protection agent for tumor chemotherapy. Inhibits cell cycle progression of normal cells and renders them resistanace to chemotherapy. No effects on tumor growth and their sensitivity to chemotherapy Phase 1 : No dose limiting toxicity, None of subjects presented grade 3 or above chemotherapy-induced neutropenia or diarrhea. Gout arthritis: Well tolerated and safe for patients who are restricted from NSAID, glucocorticoid, or colchicine.
12/27/18	GEM057	Increase hair follicle ATP and delay senescence of dermal papilla cells	Alopecia	Topical	Small molecule	Dermatosis	Phase 2	Boosts the ATP of human follicle dermal papilla cells, thereby slowing down the aging speed and prolonging hair cycle. No side effects and shorter time to observe efficacy Human trial (Androgenetic Alopecia): significantly improved 37.5% vs 0% (placebo) during 2 months. Phase 2 (Female pattern hair loss) resulted in earier improvement of hair loss and patient responses than minoxidil.
12/10/18	GEM051	Protective agents from heat stress	Heatstroke	Oral	Other	Immunology/ Inflammation	Preclinical	Suppression of vascular endothelial cell damage and production and release of inflammatory cytokines from blood cells due to heat stress. Ingredients derived from citrus fruit extract.
11/22/18	GEM050	Curcumin analogue	CML, Pancreatic cancer, Glioblastoma etc.	Oral	Small molecule	Oncology: Hematological cancer Oncology: Solid cancer	Preclinical	Inhibited proliferation of CML and pancreatic cancer cells at the submicromolar level. Unlike imatinib, the inhibitory action is irreversible. Suppressed almost completely human CML cell growth without significant changes in body weight and peripheral white blood cell count in vivo. An incease in ROS/RCS produced by inhibition of their scavenging enzymes is assumed to be involved in anti-tumor action. Induced M phase arrest.
11/15/18	GEM049	Pan-NOX inhibitor	IBD, IPF, Neurodegenerative diseases	Oral	Small molecule	Gastroenterology Immunology/ Inflammation Pain/Neuropathy Respiratory	Preclinical	Highly potent NOX inhibitor : 20~50 times more potent than GKT-137831 Significant effects in DNBS-ulcerative colitis and LPS-induced acute inflammatory animal studies. Also showed positive results in IPF animal model. High oral bioavailability and clean off-targets profile.

Drug Candidates

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
10/25/18	GEM046	Indirect activator of AMPK	Hyperlipidemia, type 2 diabetes, Cancer	Oral	Small molecule	Metabolic disease Oncology: Hematological cancer	Preclinical	Derivative of fungus product ascochlorin. Good PK profile in rats. Superior effects than metformin on blood glucose and triglyceride level in diabetic mice model. Significant enhancement of the efficacy in combination with metformin on T2D model Significant enhancement of the antitumor activity of anti-PD-1 antibody in mouse model
09/20/18	GEM042	TLR4 antagonist	NAFLD, NASH, AIH, CLD and CD	Oral	Small molecule	Gastroenterology Immunology/ Inflammation Infection Metabolic disease Rare disease	Phase 2	NAFLD (nonalcoholic fatty liver disease): The phase 2 results demonstrated significant improvement on relevant diagnosis and biomarkers. NASH: has recently been approved by US FDA for Phase 2 trial (Feb in 2020) AIH (autoimmune hepatitis; orphan designation): The phase 2 (open label) results will be available soon. CLD(chronic liver disease by HCV infection): A strong trend of improvement of liver function and safety in Phase 2. CD (Crohn's disease): Good efficacy in three Phase 2 POC studies. The drug is safe and tolerable in these trials. Can be licensed to territories except Asia
08/31/18	GEM040	Topical anti-inflammatory	Joint pain, Muscle pain, Gout, Local inflammatory pain	Topical	Small molecule	Orthopedic Pain/Neuropathy	Preclinical	Topical formulations of Ibuprofen, Naproxen, Diclofenac to use in the treatment of inflamatory pain and related conditions Formulation shows 5 to 10X increase human skin permeation coupled Potential for OTC or RX introduction: minimal development timeline
08/31/18	GEM039	Antifungal	Onychomycosis	Topical	Small molecule	Dermatosis Infection	Preclinical	Novel and unique topical formulation of Terbenafine with exceptional permeation (40 fold) across the human nail. Potential for OTC or RX introduction: minimal development timeline
08/31/18	GEM038	Locally acting anti-inflammatory- Trigeminal neuroinflammation	Migraine	Local	Small molecule	Pain/Neuropathy	Phase 2a	Clinical POC in acute migraine therapy in Phase 2a Efficacy comparable to Triptans but with no systemic side effects or restrictions Shortened development timelines (NDA:2021) Product opportunity for use in Temporomandibular Joint Disease and trigeminal neuralgias
08/31/18	GEM037	Allosteric modulator of the CCR3 receptor	Asthma, Rhinitis	Oral	Small molecule	Immunology/ Inflammation Otolaryngology Respiratory	Phase 2a	In phase 2a: Highly significant effects on the methacholine provocative response Showed trends to improvement in EAR (Early Phase Allergic Response) Reduced induced sputum eosinophil percentage and increased percent blood eosinophil
08/27/18	GEM036	Hematopoietic stem cell fucosylation	Prevention of infection & GvHD from hematopoietic stem cell transplantation	Infusion	Protein	Immunology/ Inflammation Oncology: Hematological cancer Regenerative medicine	Phase 3 ready with FDA SPA	In Phase 2 study: Statistically significant acceleration of immune system reconstitution (neutrophil/platelet recovery) Significantly reduced infection and GvHD Improved survival Positioned to be best-in-class No reports of adverse event specifically attributable to fucosylation
08/07/18	GEM034	Derivative of neuroprotective protein	Stroke, Huntington chorea, Schizophrenia and PTSD	i.v.	Peptide	CNS	Preclinical	A cell-permeable recombinant peptide. Can cross the blood-brain barrier, is resistant to degradation, and can bind constitutively to its substrates. Significantly reduces brain damage in rodent stroke model. Expected to be treated after stroke without diagnosis of stroke type before dosing.
08/07/18	GEM033	Inhibitors of bacterial resistance mechanisms	Gram-negative MDR bacterial infections, Lung infections in cystic fibrosis (CF) patients	Intravenous, Aerosol, Topical	Small molecule	Infection	Preclinical	Restore effectiveness of shelved antibiotics. Lower the effective dose of antibiotics. Mitigate antibiotic resistance. Disrupt biofilm-based infections. Over 1,000 compounds with lead compounds for each indication identified.

Drug Candidates

As of 7/30/21

Date	Candidate	Mechanism of action	Indication	Route	Modality	Disease area	Development stage	Note
07/09/18	GEM028	miRNA targeting refractory colon cancer with mutated K-ras and refractory pancreatic cancer	Pancreatic cancer Colon cancer	i.v.	Nucleic acid	Oncology: Solid cancer	Preclinical	The miRNA regulates K-ras, Bcl2, survivin, and NF-kB and demonstrate excellent antitumor effect in vitro and in vivo.
07/09/18	GEM027	miRNA targeting refractory colon cancer with mutated K-ras	Colon cancer	i.v.	Nucleic acid	Oncology: Solid cancer	Preclinical	The miRNA regulates EGFR signaling pathway by directly inhibiting of both KRAS and AKT1 and demonstrate excellent antitumor effect in vitro and in vivo.
07/09/18	GEM026	siRNA suppressing the expression of novel cancer stem cell gene "Gene A"	Cancer	i.v.	Nucleic acid	Oncology: Solid cancer	Preclinical	Novel cancer stem cell gene "Gene A", which was discovered by single cell analysis of cancer stem cell, shows character as follows. 1.Superior cancer stem cell diagnostic marker than known cancer stem cell marker CD44v9 2.SiRNA targeting Gene A demonstrate excellent antitumor effect with currnet medicines.
07/09/18	GEM025	miRNA suppressing the expression of a protein characteristic of pancreatic cancer stem cells	Pancreatic cancer	i.v.	Nucleic acid	Oncology: Solid cancer	Preclinical	Excellent antitumor effect was demonstrated in uniquely established pancreatic cancer stem cell model in vitro and in vivo.
07/05/18	GEM021	Opioid and non-opioid analgesics with respiratory stimulant	Pain	Oral	Small molecule	Pain/Neuropathy	Preclinical (close to IND)	Combination of generic opioid/non-opioid analgesics with a generic respiratory stimulant using a regulatory approach known as the 505(b)2 submission. First drug introduction therapeutically equivalent to Vicodin® that prevents overdose death, deters abuse and prevents addiction. Low cost of goods.
06/04/18	GEM020	3rd generation immunotherapy targeting little gastrin	Gastro-intestinal cancer (Pancreatic)	s.c.	Protein	Oncology: Solid cancer	Preclinical	Applied 3rd generation immunotherapy technology to little gastrin. In-vivo POC has been validated in non-human primates.
06/04/18	GEM019	3rd generation immunotherapy targeting HER2	HER2 overexpressing cancer (Breast)	s.c.	Protein	Oncology: Solid cancer	Preclinical	Applied 3rd generation immunotherapy technology to HER2. Superior efficacy to trastuzumab and pertuzumab. In-vivo PoC has been validated in non-human primates.
06/04/18	GEM018	3rd generation immunotherapy technology	Cancer	s.c.	Protein	Oncology: Hematological cancer Oncology: Solid cancer	Discovery	Unique technology that triggers B and T cells simultaneously while activating all possible natural tumor killing mechanisms available to the immune-system. Tumor-directed specific activation reduces side effects to the minimum. Applicable on a target basis.
04/10/18	GEM008	Selective cMET inhibitor	NSCLC and HCC etc.	Oral	Small molecule	Oncology: Solid cancer	Phase 2	Effective on exon 14 skipping xenograft Development by an originator has been discontinued.

Technologies

As of 7/30/21

Date	Number	Technology	Summary
07/21/21	TGEM068	AI-Powered diagnostic support	The originator offers end-to-end enterprise medical AI service as well as a wide array of pathology AI diagnostic support applications for biotech and pharmaceutical companies, ranging from slide quality control, case triaging, differential cell counting, to IHC quantification
03/15/21	TGEM067	Cancer simulator - novel paradigm in oncology drug R&D and personalised medicine	In vivo cancer simulation technology including toxicology/efficacy screening and virtual clinical trials, which reduce the need for trailing potentially dangerous therapies on patients. -Can fully replicate tumor complexity (up to 20 genetic mutations/alterations) -Can compare the efficacy of your molecule with standards of care and competitive molecules -Can be screened to find efficacious combinations using FDA-approved drugs (2,100) or any other approved library or compound library
03/24/21	TGEM066	Genetically modified adipocytes for gene therapy and regenerative therapy	Genetically modified adipocytes for gene therapy and regenerative therapy. It is developed for the treatment of various genetic disease and metabolic disorders. GMAC technology produces GMACs for treatment of many genetical diseases and intractable diseaseses by sustainable and stable secretion of transduced gene products from implant of GMACs.
01/27/21	TGEM065	Coating technology for oncolytic viruses	-There are currently 200+ Oncolytic Viruses are in clinical trials. -Without a proper delivery vehicle, many of them are under the risk of failure due to immune clearance. -This technology can protect virus from being cleared by the immune system and enable multiple dosing, systemic delivery, and higher efficacy with minimum toxicity from the coating material.
10/08/20	TGEM064	Regulation of cellular phosphate handling and intracellular energy status	Transdermal patches using nanoparticle technology for the continuous delivery of APIs as a non-invasive alternative to subcutaneous injection. Useful for small molecules and peptides including insulin. Achieves stable concentrations of APIs. Examples of use include the maintenance of blood insulin levels for the treatment of diabetes, and providing a solution for levodopa-induced dyskinesia, a side effect of L-DOPA treatment of Parkinson's disease which can be avoided by continuous transdermal delivery. Provisional patent submitted in Oct 2019 for the nanoparticle formulation. Potential for delivery through the oral or sublingual route.
09/30/20	TGEM063	Nanoparticles that can penetrate the blood brain barrier	- Nanoparticles are coated by two substances for specificity to the tumor cells. - These nanoparticles exhibited a high permeability of approximately 95% in an in vitro blood brain barrier model. - These nanoparticles exhibited complete tumor regression and mice with brain tumors survived for 80 days without any health-related abnomalities. The mice from the other groups survived only for up to 30 days.
09/29/20	TGEM062	Next-generation CAR-T cell therapy with high potency, specificity, durability, and safety	Four proprietary non-viral gene and cell engineering technologies in the chimeric antigen receptor (CAR) T cell therapies for cancer treatment. -Non-virus associated gene delivery -Huge gene loading capacity -Potential lower risk -Lower cost of goods -Competitor analysis: our superionr results
09/08/20	TGEM060	High-Yield Chinese Hamster Ovary (CHO) Cells Expression System	TGEM060 is a CHO-C expression system for preparation of reliable and stable proteins. The CHO-C expression system features: -cGMP produced and tested CHO cell line -Proprietary vectors and unique signal peptides for expression of mAbs -Robust scale-up process to 50L bioreactor -High yield and high stability (up to 5 g/L; over 100 generations) -DNA to RCB can be completed within 6 months -Simplified licensing model (e.g. royalty fee free, milestone fee free)

Technologies

As of 7/30/21

Date	Number	Technology	Summary
09/08/20	TGEM059	Site specific Antibody Drug Conjugate(ADC) Platform	TGEM059 is an efficient glycoengineering process for preparing a site specific glycoprotein-payload conjugate. - The process allows control of the drug:antibody ratio (DAR): the ADC produced is a homogeneous ADC with a DAR of 2 or 4. - Payload diversity can be achieved: the ADC can be determined to conjugate with homogeneous payloads or dual payloads for application to various cancers. - Simple manufacturing process: the conjugation process takes place in liquid phase, room temperature and can be completed overnight. - Dual-paylaod ADCs have better efficacy than random conjugated ADCs (DAR=4) in anti mesothelin and trastuzumab antibodies.
09/08/20	TGEM058	Kidney-like sphere in 3D culture system	- A novel method for the induction of a macroscopically visible three dimensional kidney-like sphere - No need to use iPS or ES cells - The very similar gene profiles to mature kidneys in human, especially natural podocytes - Can be prepared in 24 hours - Maintained a steady state for at least five days without the proliferation and a decrease in viability - Application HTP screening of drugs/chemicals in the more native setting of kidney. Evaluation of optimal personalized medicine in AKI/CKD. Human kidney diseases model library Understanding the pathogenesis of broad diseases of kidney.
08/24/20	TGEM057	Fast Production of CAR-T Cells with High Quantity and Quality	-The production is a bioprocess requiring lower number of T cells for initiation (1 to 10 million T cells), shortens the operation time to 10 days, and cultures at high cell density to 4 million cells/mL. -The process reduces equipment occupancy and material consumption. -The cell subsets were maintained at early differentiation stages, implying the increase of persistence and potency of CAR-T cells.
08/01/20	TGEM055	Enucleated mesenchymal stem cell (MSC) loaded with various functional molecules and biologics	TGEM055 is a disruptive new platform of therapeutics based on MSC-utilized technologies (de-nucleated, payload-carrying, designer-cell capabilities). - Nuclear DNA Removal - Fully Functioning Cell-Like Entity with 3-5 day Life Span - Robust Chemosensing, Migration, and Disease Homing Potential - Functional Protein Synthesis Machineries “Cell Factories - Manufactural scalable, "off the shelf"-allogeneic and biobankable
07/30/20	TGEM054	A fusion protein from two unique monoclonal antibody scfv sequences	TGEM054 is a novel monoclonal antibody technology which works against several cancers. The architecture of the fusion protein is the key that locks onto a bio-marker expressed in cancer cells. Our antibody fusion protein causes apoptosis 75 % in 7 days with two doses in vitro. It has produced molecules of high caliber tested on 24 cancer cell lines with great results. (100% of cervical cancer, 90% of bladder cancer, 90% of liver cancer).
07/20/20	TGEM053	Intranasal drug delivery	This novel Nose-to-Brain formulation allows the delivery of different molecule types (small molecules, peptides, etc.) to the brain, bypassing the blood-brain barrier and travelling along the olfactory and trigeminal nerves. This is more efficient than intravenous injection, elicits a faster onset of pharmacological activity, and requires a lower dose while ensuring a high brain concentration and low systemic concentration. This reduces side effects which are caused by the drug’s systemic action. The simple administration can be in the form of drops, sprays, pumps, cotton swabs, etc. This novel nanoparticle formulation is biodegradable and therefore safe, and can also be administered via sub-lingual, transdermal and possibly oral routes. The patent was submitted in 2020.

Technologies

GEMSEKI

As of 7/30/21

Date	Number	Technology	Summary
06/18/20	GEM207	DNA plasmid for Immunotherapies	Our original vector is designed to take manufacturing from outside the patient to inside the patient, using the patient's own cells to manufacture the necessary protein-, DNA- and RNA-based treatments.
05/27/20	TGEM051	Technologies for recreating extracellular matrix-driven cancer progression and quantifying the effects of therapeutics	Hyaluronic acid in the tumour microenvironment presents biochemical cues that drive cancer progression. Biomimetic hydrogels with hyaluronic acid are used recreate mechanisms of cancer progression to visualise the spread of cancer from local invasion to metastasis in an organ-on-a-chip. Machine vision constructs 3D maps for each patient sample in the organ-on-a-chip to track the location and health of cancer cells. Treatments are tested in parallel to compare their effects on halting cancer progression. Applications include target/drug discovery and patient selection for translational and clinical trials.
05/08/20	TGEM050	AI for Small molecule discovery service	TGEM050 performs multi-property inverse QSAR/QSPR, powered by generative AI, to discover novel, efficacious, safe, and synthesizable drug like compounds. Properties to be optimized are defined by the customer: pharmacological activity, synthesizability, ADME, and toxicity. TGEM050 can output any number of molecular structures defined by the customer, and can be re-run quickly to generate more optimized structures based on feedback.
05/07/20	TGEM049	AI based predictions for best candidate drugs	AI/ML drug discovery platform technology that predicts protein-small molecule activity. The platform can predict activity for not well characterized protein targets that have only primary sequence data available. This technology enables ultra high-speed screening for activity and specificity. The platform can be used in a wide array of applications to discover novel and repurposable drugs. It can be used for scanning molecule libraries for COVID-19 at the shorter term.
04/08/20	TGEM048	Manufacturing and use of stem cell-derived active substances	Supernatant containing stem cell-derived multiple substances which enable promoting gene expression related to tissue engineering such as growth factors. The supernetant may be used for cosmetics, and pharmaceuticals for the treatment of atopic dermatosis, alzheimer and reumatoid arthritis.
03/06/20	TGEM047	Innovative transparent film-forming and bioadhesive delivery technology	TGEM047 is a versatile topical bioadhesive film-forming vehicle (platform) with occlusive or semi occlusive characteristics and sustained release properties for an adequate vehiculization of lipophilic and hydrophilic components. It can also be used as a vehicle for the inclusion of other technologies (micro, liposome, nanoparticles etc). This technology has been successfully applied to different topical molecules demonstrating an improvement on the API's bioavailability profile as well as providing more adequate formulations for patient treatment adherence.
03/06/20	TGEM046	Proliferation control of Mononegavirales using photoswitching system	Mononegavirales are promising tools as oncolytic vectors and transgene delivery vectors for gene therapy and regenerative medicine. By using the specifically designed proteins, which reversibly heterodimerize upon blue light illumination, photocontrollable mononegaviruses (measles and rabies viruses) were generated. The proteins were inserted into the flexible domain of the viral polymerase, and the oncolytic virus showed strong replication and oncolytic activities only when the viral polymerases were activated by blue light illumination. Treatment of this oncolytic virus resulted in a substantial reduction in tumor growth and prolonged survival under the blue light
03/06/20	TGEM045	Superior gene expression using photoswitching system	Fusion system of CRISPR-dCpf1 and novel photoswitching system. An improved split dCpf1 activator, which has the potential to activate endogenous genes more efficiently than a previously established dCas9 activator. The split dCpf1 activator can efficiently activate target genes in mice and provides an efficient and sophisticated genome manipulation in the fields of basic research and biotechnological applications.
03/06/20	TGEM044	ON/OFF control of mice genome recombination using photoswitching system	Fusion system of Cre–loxP recombination system and novel photoswitching system. Enables sharp induction (up to 320-fold) of DNA recombination and is efficiently activated even by low-intensity illumination (~0.04 W m-2) or short periods of pulsed illumination (~30s). Allows for efficient DNA recombination in an internal organ of living mice through noninvasive external illumination using an LED light source.

Technologies

As of 7/30/21

Date	Number	Technology	Summary
03/06/20	TGEM043	ON/OFF control of gene expression using photoswitching system	Fusion system of CRISPR-dCas9 and novel photoswitching system. Enables high blue-light-inducible activation of endogenous target genes in various human cell lines. Induced neuronal differentiation in iPS cells by achieving the activation of target genes.
03/06/20	TGEM042	ON/OFF control of gene editing using photoswitching system	Fusion system of CRISPR-Cas9 and novel photoswitching system. Induces targeted genome sequence modifications through both nonhomologous end joining and homology-directed repair pathways in response to blue light irradiation and can be switched off simply by extinguishing the light. Determines time-specific and location-specific activation by the irradiation.
03/06/20	TGEM041	Novel photoswitching system for optogenetic control of gene editing and expression	This system consisting of two proteins can control the activity of cellular proteins by the optogenetic method. These new proteins were engineered to enhance light-induced heterodimerization and show faster kinetics than any of the other conventional dimerization-based blue spectrum photoswitches. This is a powerful tool that can optogenetically manipulate molecular processes in biological systems.
02/18/20	TGEM040	Genome editing technology using oligonucleotides	The genome editing technology uses oligonucleotides only and requires neither protein nor double-strand break. Editing is highly selective and there are no by-product, which enables editing as intended without off-target risks. Easy administration to living body.
02/12/20	TGEM039	Multi Targeted Drug Delivery using Peptide Drug Conjugates (PDC's)	A novel Smart, Multi-Armed linker which is patented. The linker can bind up to three payloads –chemotherapeutic agents for treatment or fluorescent for diagnostics. The linker releases the payloads only in the Tumor cells and only after release the drugs become active and the fluorescent changes colors or starts to shine. We proved that Conjugates with dual drug payloads (multi-loading) resulted in enhanced cytotoxic effect towards cancer cells and less drug resistance evolved in comparison with mono-loaded counterparts. The novel linker can be used for PDC's, Antibody DC's(ADC's) and Nano-particle DC's(NDC's). An innovative technology for PDC's - a unique technology to synthesize cyclic peptides which are stable, selective and non-immunogenic. We can identify Receptors which are overexpressed in certain forms of cancer and synthesize peptides which will bind to these receptors so that we can use them for Targeted Drug Delivery.
01/16/20	TGEM038	A novel cell therapy platform to regenerate tubular organs	Proprietary and biocompatible scaffold (temporary cell delivery device) is combined with a patient's own cells (haematopoietic stem and precursor cells) to create an esophageal implant that could potentially be used to treat pediatric esophageal atresia and other conditions that affect the esophagus. TGEM038 can also be extended to other tubular organs, including the bronchi and trachea.
01/08/20	TGEM037	Novel *Escherichia coli-Mycobacterium* shuttle vector	TGEM037 has the following strengths compared to other vectors and expected to induce enhanced immune responses. • High stability and compatibility • High copy number in mycobacteria • Stable expression of exogenous genes in mycobacteria
07/02/21	TGEM036	Biologics manufacturing platform to cut manufacturing cost by up to 90%	Our manufacturing system - High yield production of antibodies, vaccines and proteins - Ultra-low cost production - Production of products that are hard to express by fermentation. - Controllable modification of glycosylation. The biosimilars of the following biologics are in development phase. - Lucentis, Avastin, Herceptin, Keytruda

Technologies

GEMSEKI

As of 7/30/21

Date	Number	Technology	Summary
11/29/19	TGEM035	Effective platform using highly branched glucan for DDS carrier	Highly branched glucan has very attractive characteristics, such as a spherical nano-sized particle, high water solubility, narrow molecular size distribution, and the numerous modifiable residues, as a dendrimer for pharmaceutical application. Established technology enables to control the average particle size of this glucan between 10 nm and 50 nm strictly, and to conjugate the functional substances, such as peptide, nucleotide, sugar chain, anticancer drug, and antibody, on the surface of its particle arbitrarily. The structural features of this polymer could permit drug delivery to specific tissues and multivalent interactions with target molecules. This glucan is an effective platform for DDS carrier such as vaccine and anticancer drug.
11/05/19	TGEM033	Long-term sustained release microformulations	This technology platform enables long-term sustained release of a drug into the blood from the administration site and treatment with once in 1 month to 6 months. The best polymer among more than 15 kinds of polymers can be proposed based on the results of feasibility studies. Opportunity for using this technology is limited to Japanese companies.
09/30/19	TGEM032	Cell Therapy technology platform for developing cell-based products for multiple chronic diseases	Novel and propreitary cell therapy platform technology that can be used for the development of cellular therapies. Cellular therapies are the new modality of treatment that provides long-term cures for chronic diseases. This platform can be applied across multiple disease areas-musculoskeletal disorders,urogynacology, oncology,cardiology. Three pronged approach to tackle degenerative diseases through drug/biologic/device mechanisms.
08/21/19	TGEM031	Delivery of anticancer drugs to cancer cells	TGEM031 is a modified β-Cyclodextrin and increased in vitro antitumor activities of doxorubicin (DOX), vinblastine and paclitaxel. The complex of DOX with TGEM031 markedly increased antitumor activity of DOX, after intravenous administration to tumor-bearing mice.
07/31/19	TGEM030	Innovative technology enabling improved GI absorption of the insoluble drug	A patented technology based on lipidic compositions which form optimal dispersed phase in the gastrointestinal environment for improved absorption of the insoluble drug. TGEM030 enables development of superior oral products with: Improved solubilization and high drug loading capacity, improved bioavailability, faster and more consistent absorption leading to reduced variability and reduced sensitivity to food effects. TGEM030 utilizes bioacceptable excipients and conventional manufacturing processes.
07/08/19	TGEM029	Sustained release PLGA	Poly lactide-co-glycolide acid (PLGA) microsphere technology for sustained release of drugs. Versatile drug release profiles could be achieved by adjusting the formulation compositions and effective plasma drug concentration could be maintained for several weeks or months upon one injection. In addition, the pharmacokinetic and pharmacodynamics evaluation models for sustained release technology have been established which could speed up product development.
07/08/19	TGEM028	Posterior eye delivery	An ocular delivery technology specially designed to topically deliver hydrophobic small molecular across ocular tissues into posterior ocular tissues. The eye drop based delivery technology can overcome the delivery obstacle of tissue barriers to transport therapeutics to posterior ocular target tissue. This breakthrough technology is expected to bring broader applications for posterior ocular drug delivery
07/08/19	TGEM027	Site-specific linker toxin	The disadvantages of traditional conjugation technologies include the lack of specificity at the connecting positions of the antibodies and the variable number of connections. The new technology can overcome these disadvantages by improving homogeneity of ADC via site-specific conjugation. The site-specific linker-toxin shows better homogeneity, stability and efficacy.
07/08/19	TGEM026	Intracellular delivery	This technology enables peptide and oligonucleotide drugs to be delivered efficiently into cells through conjugating a cell-penetrating motif (CPM) onto drug candidate. Unlike liposomal or other nanoparticle formulation, the CPM technology requires no encapsulation process and provides formulated drug product with high stability and storage condition tolerances.
05/30/19	TGEM024	Novel lymphatic delivery system	A novel hyaluronic acid-based nanocarriers that could deliver more drug to lymph nodes. This delivery system may offer significant advantages for the use of platinum medicines in the management of locally advanced cancers. Organic solvent-free nanocarriers process. Active targeting to lymph node and tumor

Technologies

As of 7/30/21

Date	Number	Technology	Summary
05/30/19	TGEM023	Innovative formulation for insoluble drugs	Novel platform of formulation design and evaluation include concept of formulation design, composition of formulation, in vitro dissolution study, and in vivo absorption test. This new concept of formulation design utilizes solubility buster with traditional excipient to resolve solubility problem of drugs. This platform could be widely applied to BCS II drugs and shorten development process. Traditional excipient and solubility buster are commercial products that are easy to purchase without limitation.
04/02/19	TGEM022	Innovative nanoparticle formulation	Achieved higher content of drug, more homogeneous particle size distribution, lower cost (1/10) and easier mass production compared to conventional methods. Easy to control particle size (2 nm ~ 500 nm). Provide DDS function to the drug and stay the drug in the cell for a long time. Enable re-development of compounds that abandon development with side effects and insufficient effect. The substrate used in the nanoparticle formulation are used in approved medicines (FDA).
02/12/19	TGEM021	A unique and effective transdermal delivery technology for small molecule drugs	Can formulate patches with very high payload: Up to 50wt% achieved for drug and excipients, Extended release (24h up to 7-day) formulations possible, Fantastic adhesion, Water-resistant , Comfortable to wear and to remove. Efficient release of drug with improved skin penetration through formulation of free base/acid of API (not a salt)
01/07/19	TGEM019	Novel patented dermal delivery system	Silica delivery particles are loaded with an active ingredient. Technology is compatible with most small molecule/peptide payloads. The silica particles embed into the stratum corneum creating a resevoir of active ingredient diffusing out over a 12-24 hour time period (depending on active). The particles can be tuned based on desired active and properties to adjust loading, release rate, and others. Depending on the chosen payload and the clinical objective, the particles can be as small as ~300 nanometers in size...and up to ~10 microns. Demonstrated efficacy and safety in multiple animal models of disease. Breakthrough technology with strong IP protection. Applications in Rx, cosmeceutical, and animal health.
12/10/18	TGEM014	Determination method for NK cell activity	Simple and quick method for determination of NK cell activity which is applicable to whole blood. The amount of IFN-γ or TNF-α produced by activated NK cells in whole blood is used as an indicator of NK cell activity. Neither radioactive isotopes nor separation steps from blood cells are required.
10/09/18	TGEM013	SUMO-fusion protein expression technology	Enables the efficient lower-cost production and purification of high quality, correctly folded proteins useful in all applications of protein preparation and drug discovery. High expression levels Variations optimized for insect, mammalian, E.coli and yeast. Non-exclusive licensing.
10/09/18	TGEM012	The methods and tools relating to UPS	The methods and tools for discovery of ubiquitin pathway system (UPS) enzyme functions and modulating molecules. This technology enables the following assays. HTS and validation assays of deubiquitinase (DUB) activity and E2, and E3 ligase Cellular ubiquitylation activity We are launching a new proteomics service that utilizes the TUBE technology to get better mass spec data about ubiquitylated proteins.
08/31/18	TGEM011	Novel topical drug delivery technology	Enables superior transdermal penetration of active ingredients to the target tissue Suitable for most APIs and drug classes Minimizes systemic exposure and side effects Improved API photostability (No degradation upon sun exposure) Formulated with all GRAS (generally recognized as safe) excipients

Technologies

As of 7/30/21

Date	Number	Technology	Summary
08/27/18	TGEM010	Fucosylation technology for cell immunotherapy	Improved delivery of therapeutic cells Applicable to hematopoietic stem cells, cytotoxic and regulatory T cells (Treg), CAR-T, mesenchymal stem cell and NK cells Simple and rapid procedure
07/09/18	TGEM009	Technology establishing cancer stem cell	Established the cancer stem cell model that can produce in vivo tumor from one cancer stem cell. In vivo tumor were formed from 10 cells in cell lines established from patient derived tissue of metastatic colorectal cancer as well as from in vitro cell lines.
07/05/18	TGEM008	A platform technology that allows any cell to continuously produce a bioluminescent signal representative of its real-time metabolic activity level	This technology removes steps from, and allows the continuous measurement of, cell-based in vitro and animal imaging-based in vivo assays. No negative effects on host cells and correlation with alternative assays are validated. Licenses available for pre-made cell lines or the technology platform.