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Medicon Valley Alliance

Drug Delivery Initiative

- Mapping of Drug Delivery Competences in Medicon Valley

Medicon Valley Alliance, September 2010

Torsten Jepsen
Senior Project Manager

EUROPEISKA UNIONEN
Europeiska regionala utvecklingsfonden

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Contents

Introduction

The report at hand provides the input for the third Steering Group meeting within the Medicon Valley Drug Delivery Initiative.

The report contains a mapping of drug delivery activities and competences in Medicon Valley. Included in the drug delivery mapping is:

- ✓ R&D projects in Medicon Valley with the purpose of developing new drug delivery platforms/technologies
- ✓ Drug development projects using a novel and patented drug delivery platform/technology
- ✓ Services provided by CRO or CMO with a drug delivery purpose, and
- ✓ Already marketed drugs or drug delivery devices using a patented drug delivery technology

The main purpose of the last Steering Group Meeting is to get the Steering Group's buy-in on the proposal outlined for strengthening drug delivery research in Medicon Valley. The proposal has already been shared with the steering group. The mapping report shall be read as supplement to the proposal and provide facts about the current level of capacity within drug delivery in Medicon Valley.

The mapping report doesn't state Medicon Valley's relative strength in drug delivery vís-a-vís other cluster around the world, but provides an overview of the competences available in Medicon Valley. The mapping report is moreover objective and doesn't rate some research projects or technological platforms over others. It is up to the steering group to add qualitative value to the mapping if assessed necessary.

Methodology

The mapping has been conducted in the period from April-August 2010.

Biotech companies, medtech companies, CROs and CMOs have been mapped using information available on the internet. All websites for companies located in Medicon Valley within the abovementioned categories have been examined.

The total number of websites visited is:

- 85 biotech
- 180 medtech
- 30 CMO
- 30 CRO (Please note that only preclinical CROs have been included in the mapping).

If the company website does not reflect any drug delivery related activities, it has not been included in the mapping.

University research has been mapped through personal contacts. Researchers working with drug delivery have been identified at each of the universities and information was collected through yearly reports and personal interviews.

Activities at the pharmaceutical companies have been mapped using information from yearly reports and information derived from personal interviews.

Research conducted at the university hospitals has not been mapped yet due to limited resources, but will be if this initiative is taken further.

The data presented in this report has not been externally reviewed and verified. This is recommended should the initiative be taken further.

Drug Delivery Definition

The mapping has been conducted using a broad definition of drug delivery as presented below.

A drug delivery system is defined as a formulation or device that enables the introduction of an active pharmaceutical ingredient (API) to its site of action.

The overarching aim of any drug delivery system is to improve the efficacy, safety and compliance regarding the medicinal product. This can be achieved by implementing various drug delivery technologies that enable improved bioavailability, targeted delivery, or an alternative route of administration etc.

A drug delivery system should not exert a pharmacological effect in the absence of the API. In this context monoclonal antibodies (mAB) represent a gray area as they have the ability to exert targeted therapy themselves. It must therefore be stressed that mABs can only be

regarded as a drug delivery system if they are associated with an API e.g. by means of conjugation or as part of a liposome and hence that the possible pharmacological effect of the mABs alone is regarded as inferior. In medicinal products where the main pharmacological effect derive from the mAB, the mAB is the actual API and hence not a delivery system.

Though the primary goal of drug delivery technologies is to ensure better therapy, the technologies can also be implemented in other parts of the medicinal sector. The targeted delivery of drugs used in cancer treatment can be used to develop diagnostic tools for cancer and vice versa. The technology used in diagnostics might be similar to technologies used in drug delivery and to distinguish the two it is essential to investigate the purpose of the technology.

The broad definition of drug delivery has been used to map the following:

- ✓ R&D projects in Medicon Valley with the purpose of developing new drug delivery platforms/technologies
- ✓ Drug development projects using a novel and patented drug delivery platform/technology
- ✓ Services provided by CRO or CMO with a drug delivery purpose
- ✓ Already marketed drugs or drug delivery devices using a patented drug delivery technology

The mapping does not include information on:

- Generic drug delivery platforms used by biotech and pharma companies in Medicon Valley
- Research that indirectly may provide value to drug delivery research ie. mathematic modeling etc.

Summary of Mapping Results

A total of 55 organizations in Medicon Valley have drug delivery R&D activities or drug delivery products on the market (see chart 1).

Biotech companies account for 31% (17 in total) of these organizations. Most of these biotech companies are employing a patented drug delivery platform for developing drugs, and has little research with the purpose of developing novel drug delivery technologies.

11 pharmaceutical companies have drug delivery R&D activities or marketed products using a novel drug delivery technology. More than half of the companies (ALK, AstraZeneca, Ferring Pharmaceuticals, LEO Pharma, Lundbeck and Novo Nordisk) have ongoing drug delivery focused R&D projects of which many are in collaboration with the universities in Medicon Valley. The scope of drug delivery R&D, however, differs significantly in the pharma companies. Novo Nordisk has several dedicated units working with different aspects of drug delivery whereas other companies only employ a few PhDs. McNeil Sweden and Niconovum are both working with nicotine replacement therapy but has in this mapping been classified as pharmaceutical companies.

A large number of CRO/CMOs in Medicon Valley (10 in total) provide drug delivery related R&D services. Most of these service providers offer formulation development and modified release services.

Nine Medicon Valley medtech companies have drug delivery as their business focus area. Most of the companies already have products on the market such as stents, inhalers and injections. Due to confidentiality reasons the mapping does not contain the device products under development.

Four universities in Medicon Valley are conducting drug delivery research. University of Copenhagen and Lunds University each have four faculties/departments that are conducting research in drug delivery. At the Technical University Denmark (DTU), drug delivery research is conducted at the Department for Micro- and Nanotechnology and at Malmö University drug delivery research is conducted at Research Center for Biointerfaces.

Last, four probiotics companies with novel drug delivery technologies are located in Medicon Valley. Three of these companies employ coating and encapsulation technologies to deliver viable microorganisms and one company have

developed novel devices to deliver the microorganisms.

For a detailed description of the organisations please see appendix 1.

Segmentation by type of APIs

The Medicon Valley drug delivery R&D activities and drug delivery products are mainly focused on delivery of small molecules (see chart 2). In total, 40 organisations are working with novel delivery of small molecules whereas 28 organisations are working with novel delivery of biologics. Please note that organisations working with novel delivery of both small molecules and biological are included in both categories. Organisations working exclusively with viable microorganisms are not included in chart 2.

It is useful to notice that 10 biotech companies are developing small molecule drugs on novel delivery platforms, whereas 13 biotech companies are working with biologics. Conversely most pharmaceutical companies are working with small molecules. The same difference is seen in contract organisations and medtech organisations where more than twice as many companies are working with novel delivery of small molecules and only one company in each group are working with biologics.

Looking only at delivery of biological drugs we see that most organisations focus on delivery of peptides ad proteins (see chart 3).

Segmentation by technologies types

The organizations in Medicon Valley engaged with drug delivery apply a wide range of different technologies (see chart 4). The technology types applied by most organizations for drug delivery purposes are implant/depots, coating and encapsulations and inhalations whereas the technology types applied by least organizations are gene based targeting and, solid dispersion and needle free injectors.

Looking at universities, biotech and pharmaceutical companies isolated the most popular drug delivery technology types are nanoparticles, implants/depots and linker technology.

Segmentation by therapeutic areas

The organizations in Medicon Valley with a novel drug delivery focus are working with a wide range of therapeutic areas (see chart 5). The therapeutic area where most drug delivery focused organizations are engaged is cancers and neoplasms. 10 biotech companies alone focus on cancer and neoplasms. Looking at pharma and the universities isolated, hormone related diseases is the most popular therapeutic area.
The high prevalence of organizations focusing on digestive system diseases is related to the inclusion of the four probiotic companies in this mapping.

Charts and Matrices

Chart 1: Type of organisations working with drug delivery

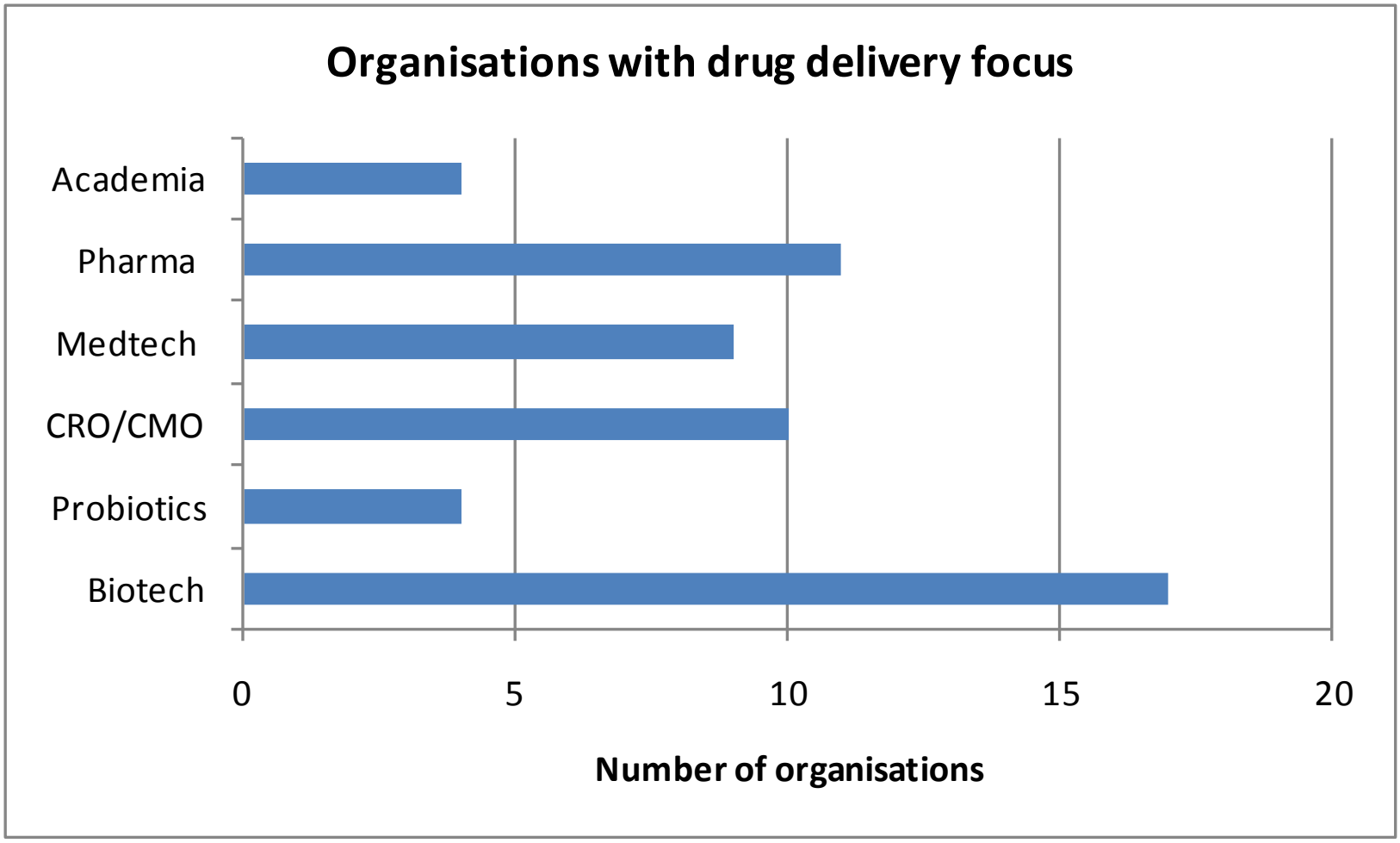


Chart 2: Delivery of biolgicals and small molecules by type of organisation

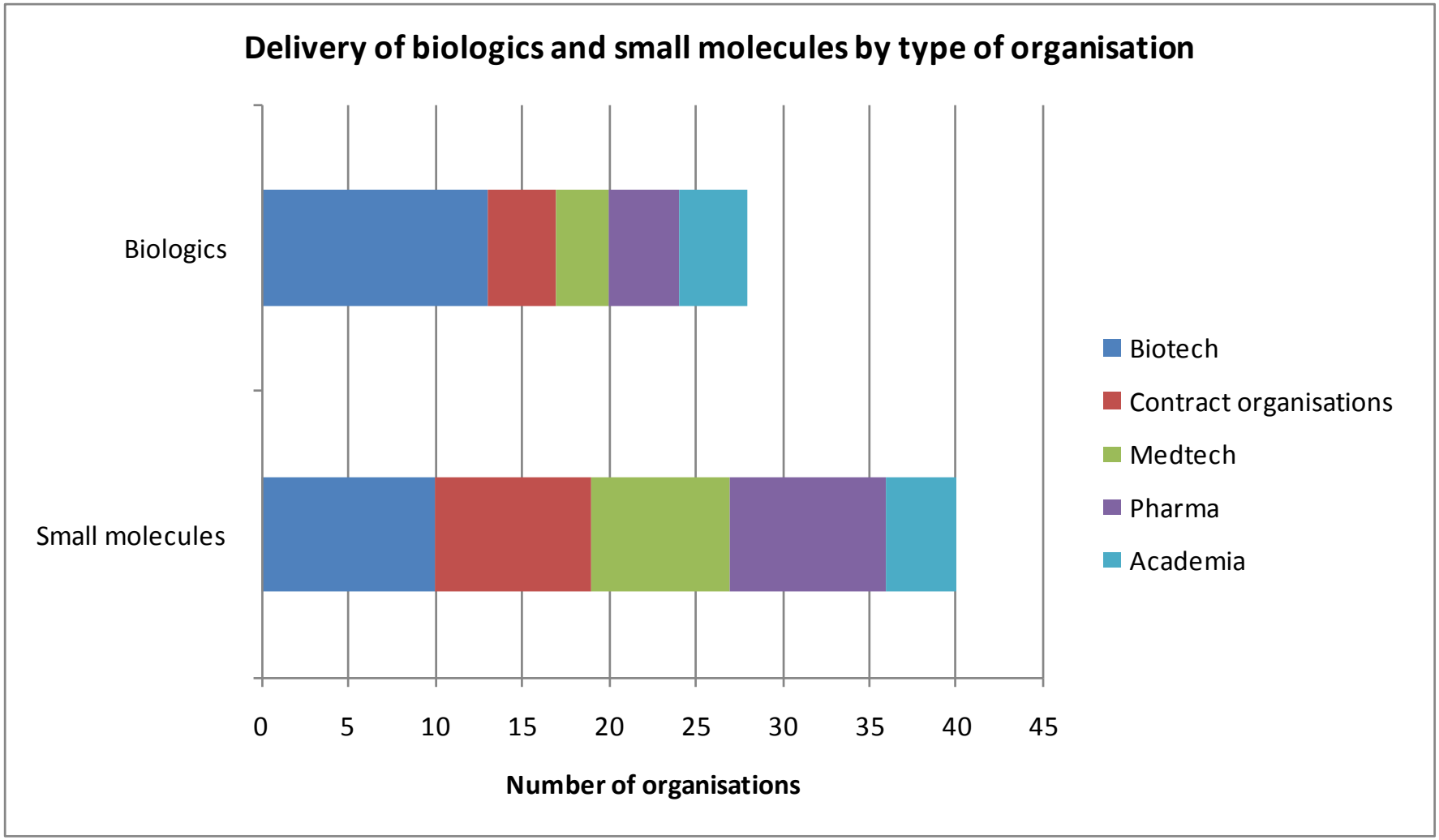


Chart 3: Delivery of biologicals by type of organisation

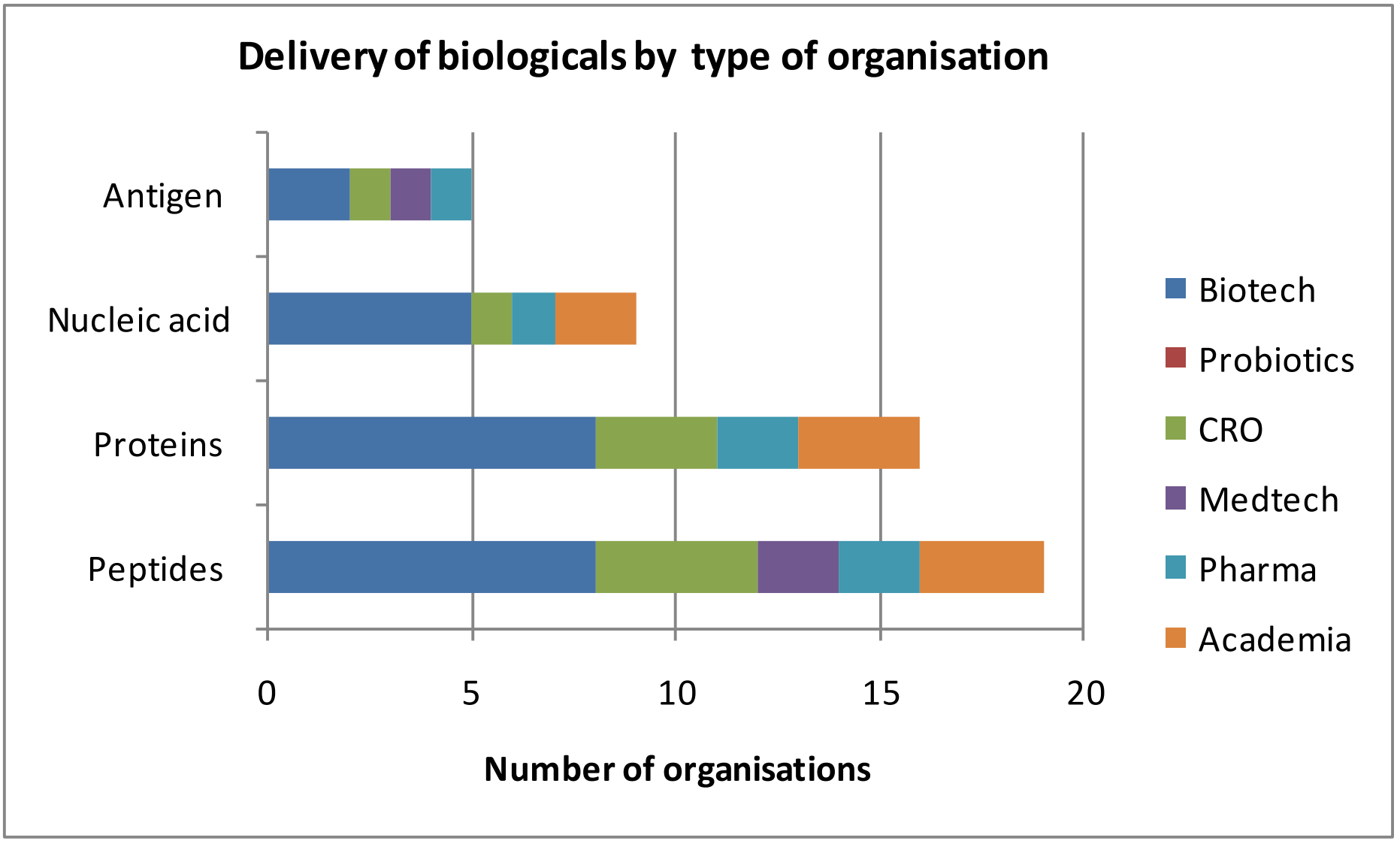


Chart 4: Technology type by organisation

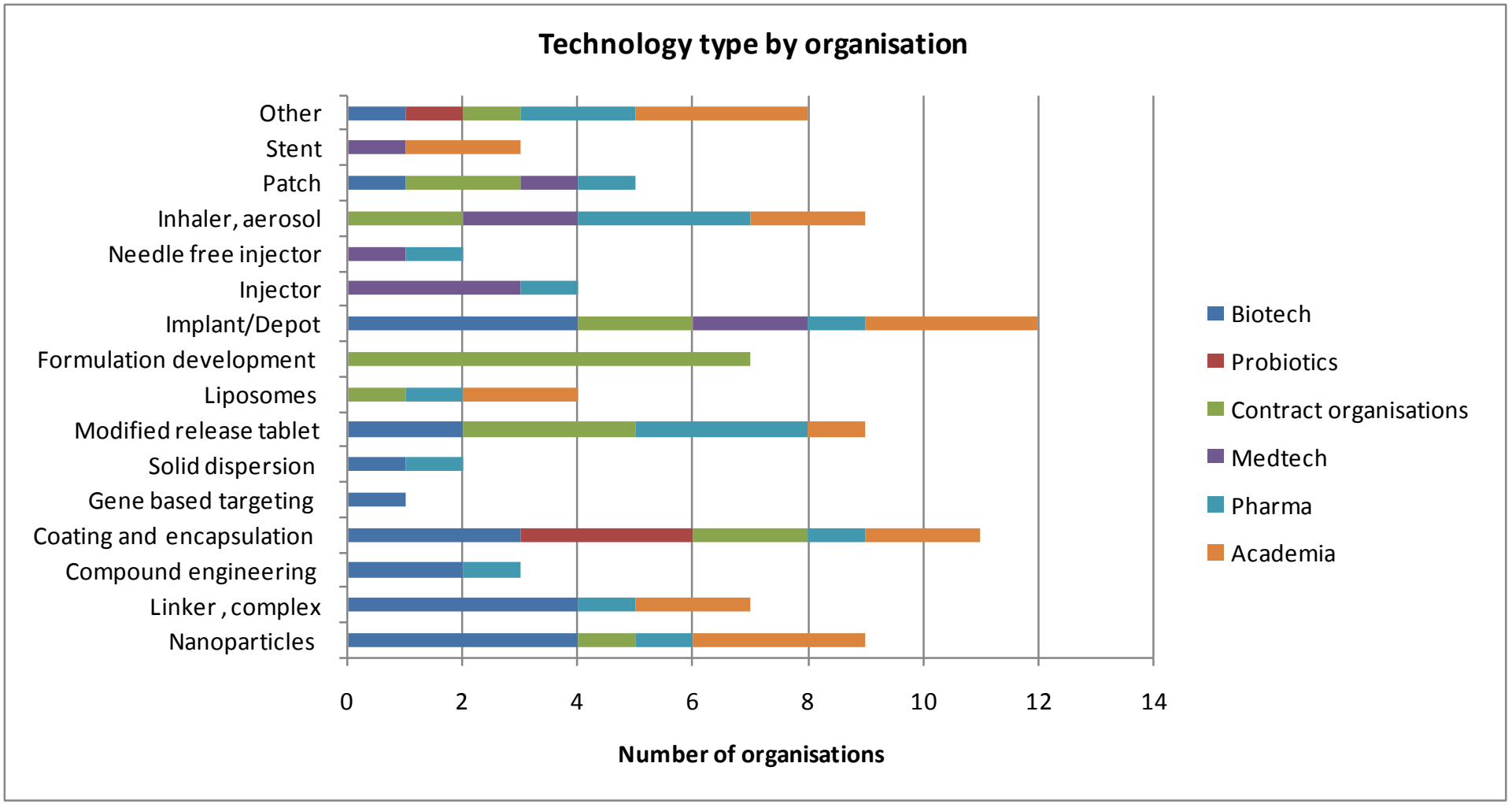
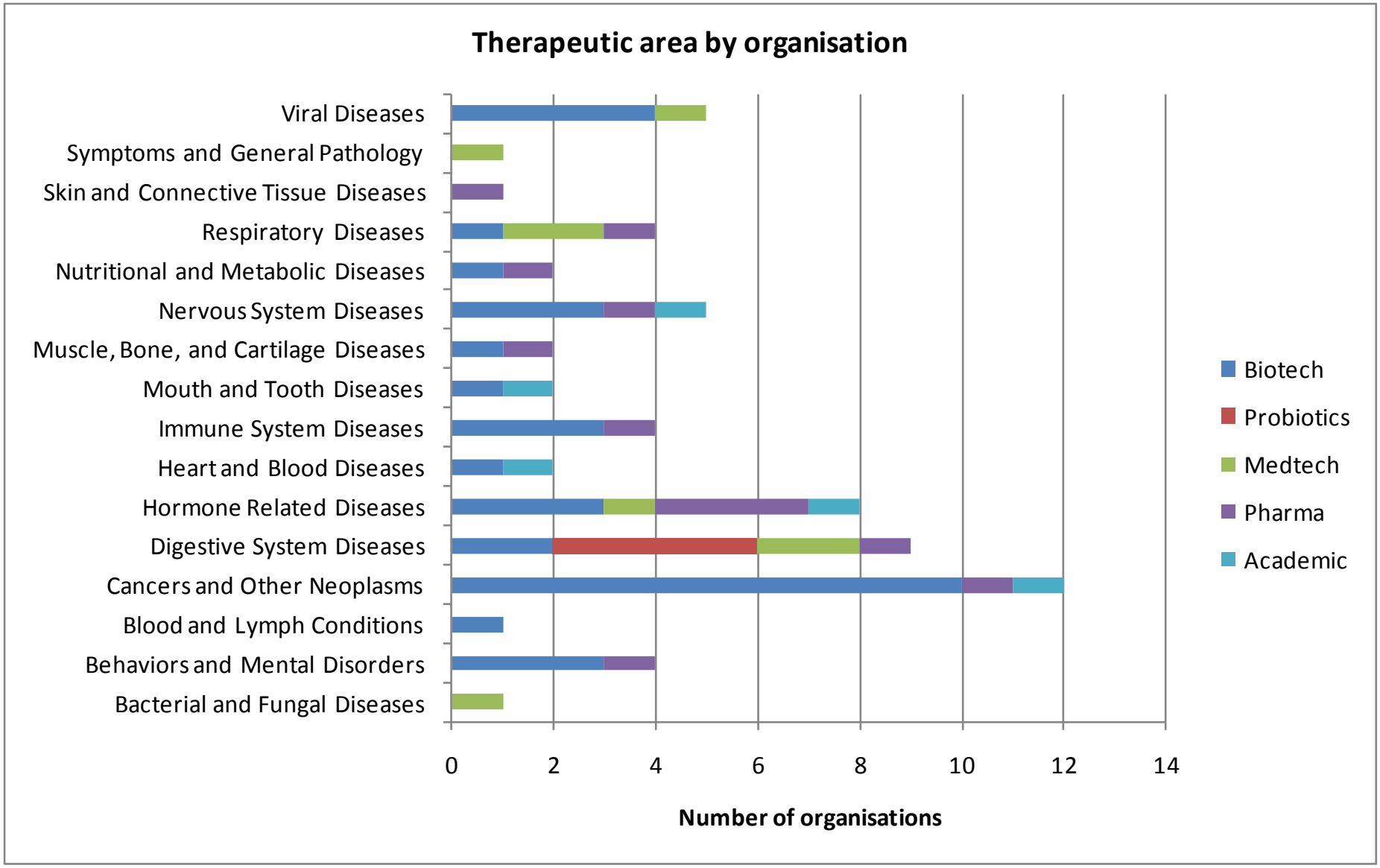


Chart 5: Therapeuctic area by organisation



Matrix 1: Organisation overview (API and type of technology)

		Biotech																	Probiotics				Contract organisation										Medtech									Pharma												Academic			
		AcuCort AB	Ascendis Pharma A/S	Camurus AB	Egalet A/S	Life Cycle Pharma A/S	LiPlasome Pharma A/S	Magle AB	Meabco A/S	Nordic Vaccine A/S	Novozymes A/S	NsGene A/S	Santaris Pharma A/S	StratoSphere Pharma AB	TikoMed AB	TopoTarget A/S	Zealand Pharma A/S	Zgene A/S	Bifodan A/S	Biogaia AB	Cell Biotech Europe A/S	Probi AB	Active Biotech AB	Bioglan AB	Bioneer A/S	Bioperm AB	Chemilots A/S	Galenica AB	Genovis AB	Qpharma AB	Rechon Life Science AB	Recipharm	Bang & Olufsen Medicon A/S	Biomodics	Clinova medical AB	Codan Steritex ApS	Emunio ApS	Laccure AB	NOLabs AB	Union Medico ApS	William Cook Europe ApS	ALK Abelló A/S	AstraZeneca	DuoCort AB	Ferring Pharmaceuticals A/S	Leo Pharma	LIDDS AB	H. Lundbeck A/S	McNeil Sweden	Niconovum AB	Novo Nordisk A/S	Pharmacosmos	Lund University	Malmo Universisty	Technical University of Denmark	University of Copenhagen
	# of platforms/services/prodcuts/ Faculties	1	3	6	3	1	1	1	1	2	5	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	4	1	1	1	2	1	1	1	1	1	1	1	1	2	1	2	5	3	3	1	4	1	1	4
Drug type	Small molecules	X	X	X	X	X	X	X	X		X			X									X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X
	Peptides		X	X			X	X			X			X	X		X											X	X		X	X	X										X	X				X		X	X		X	X
	Proteins		X	X				X			X	X		X	X	X												X																X	X				X			X	X	X		X
	Nucleic acid						X	X			X		X					X											X																X								X	X			X
	Antigen									X	X																	X								X					X														
	Viable microbes																		X	X	X	X						X																												
	N/A																															X																							
Technology type	Nanoparticles			X			X			X	X																		X																X								X		X	X
	Linker , complex		X						X		X					X																																						X			X
	Compound engineering												X				X																																					X			
	Coating and encapsulation				X			X						X					X		X	X				X						X												X								X		X	
	Gene based targeting																	X																																							
	Solid dispersion					X																																																			
	Modified release tablet	X			X																						X		X		X											X		X								X			
	Liposomes																							X																															X	X
	Formulation development																						X	X			X	X		X	X	X																							
	Implant/Depot		X	X								X			X												X			X			X				X																X	X		X
	Injector																															X				X			X																	
	Needle free injector																																		X																						
	Inhalation																							X						X		X											X								X	X			X
	Patch									X																	X							X						X									X						
	Stent																																																				X	X		
	Other				X															X						X																										X	X			X
	N/A																																																						

Matrix 2: Organisation overview (Therapeutic area)

		Biotech																	Probiotics				Contract organisation										Medtech									Pharma												Academic			
		AcuCort AB	Ascendis Pharma A/S	Camurus AB	Egalet A/S	Life Cycle Pharma A/S	LiPlasome Pharma A/S	Magle AB	Meabco A/S	Nordic Vaccine A/S	Novozymes A/S	NsGene A/S	Santaris Pharma A/S	StratoSphere Pharma AB	TikoMed AB	TopoTarget A/S	Zealand Pharma A/S	Zgene A/S	Bifodan A/S	Biogaia AB	Cell Biotech Europe A/S	Probi AB	Active Biotech AB	Bioglan AB	Bioneer A/S	Bioperm AB	Chempilots A/S	Galenica AB	Genovis AB	Qpharma AB	Rechon Life Science AB	Recipharm	Bang & Olufsen Medicon A/S	Biomodics	Clinova medical AB	Codan Steritex ApS	Emunio ApS	Laccure AB	NOLabs AB	Union Medico ApS	William Cook Europe ApS	ALK Abelló A/S	AstraZeneca	DuoCort AB	Ferring Pharmaceuticals A/S	Leo Pharma	LIDDS AB	H. Lundbeck A/S	McNeil Sweden	Niconovum AB	Novo Nordisk A/S	Pharmacosmos	Lund University	Malmo Univeristy	Technical University of Denmark	University of Copenhagen
	# of platforms/services/prodcuts/ Faculties	1	3	6	3	1	1	1	1	2	5	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2	1	1	4	1	1	1	2	1	1	1	1	1	1	1	2	1	2	5	3	3	1	4	1	1	4
Therapeutic area	Bacterial and Fungal Diseases																																				X																			
	Behaviors and Mental Disorders		X	X	X																																	X																	
	Blood and Lymph Conditions														X																																	X							
	Cancers and Other Neoplasms			X			X	X	X		X		X		X	X	X	X																													X							X	
	Digestive System Diseases					X											X		X	X	X	X																		X	X					X									
	Eye Diseases																																																							
	Hormone Related Diseases		X	X													X																	X											X							X			
	Heart and Blood Diseases																X																																				X			
	Immune System Diseases	X				X									X																											X													
	Injuries and Poisonings																																																						
	Mouth and Tooth Diseases			X																																																			
	Muscle, Bone, and Cartilage Diseases																X																																				X			
	Nervous System Diseases		X		X							X																																									X			X
	Nutritional and Metabolic Diseases																X																																				X			
	Respiratory Diseases	X																															X		X							X												
	Skin and Connective Tissue Diseases																																																						
	Symptoms and General Pathology																																																						
	Viral Diseases		X							X	X		X																								X																	
	N/A			X										X									X	X	X	X	X	X	X	X	X	X		X		X																			

Appendix A: Medicon Valley Drug Delivery Data

6.1 Biotech companies

Name	AcuCort AB
Description of organisation	N/A
Technology name	Oral rapid-release glucocorticoid
Patented	N/A
Status	N/A
Delivery of	Small molecules (glycocorticoid)
Therapeutic area	Immune system disease, Respiratory disease
Mode of administration	Oral
Technology purpose	The development of rapid onset, convenient, needle-free for use in acute asthma attacks and similar conditions.
Technology type	Modified release tablet
Technology description	The technology platform is an oral rapid-release glucocorticoid designed to be administered outside of a hospital or other medical setting by one's self or by non-medically trained people, and to a patient who is unconscious or otherwise unable to swallow. The disease focus is acute therapy and emergency situations, such as acute allergy and asthma, adrenal crisis, anaphylactic reactions and trauma

Name	Ascendis Pharma A/S
Description of organisation	Ascendis Pharma A/S is an emerging speciality pharmaceutical company which is creating improved, patentable versions of both currently marketed drugs and high value development-stage opportunities. The prodrug technology enables Ascendis Pharma A/S to do this.
Technology name	TransCon Hydrogel
Patented	Yes
Status	Technology platform is developed – most mature compound using the technology is in preclinical phase
Delivery of	Peptides and small molecules
Therapeutic area	Hormone related diseases, Behavior and mental disorders, Nervous system diseases
Mode of administration	Injectable SC (Daily to quarterly)
Technology purpose	Controlled sustained release. Lowering the risk of adverse effects. Improve the stability in vivo.
Technology type	Depot, implant
Technology description	The uniqueness of the technology is based on self-cleaving linkers specifically designed to autohydrolyze at a predictable rate. Cleavage rates can be engineered to give an optimal pharmacokinetic profile. TransCon release kinetics are characterized by very low inter- and intra-patient variability. The TransCon Hydrogel platform is a highly innovative self-eliminating hydrogel, capable of delivering the drug payload prior to biodegradation into small PEG entities that

	subsequently are cleared renally. As soon as the hydrogel is injected, the TransCon linkers start to release the drug molecules in a sustained controlled manner for up to three months. The hydrogel protects the API from biodegradation.
Technology name	**TransCon PEG**
Patented	Yes
Status	Technology platform is developed – most mature compound using this delivery platform is in phase I
Delivery of	Protein and Peptides
Therapeutic area	Hormone related diseases, Viral diseases
Mode of administration	Injectable SC (Daily to fortnightly)
Technology purpose	Controlled sustained release. Lowering the risk of adverse effects. Improve the stability in vivo.
Technology type	Linker, complex
Technology description	The uniqueness of this technology is based on self-cleaving linkers specifically designed to autohydrolyze at a predictable rate. Cleavage rates can be engineered to give an optimal pharmacokinetic. TransCon release kinetics are characterized by very low inter- and intra-patient variability. Conjugation to a PEG carrier molecule creates a prodrug that circulates in the plasma, continuously releasing the unmodified drug for up to two weeks. The PEG carrier molecule hinders biodegradation of the API
Technology name	**TransCon Albumin**
Patented	Yes
Status	Technology platform is developed
Delivery of	Small molecules
Therapeutic area	N/A
Mode of administration	Injectable IV (Weekly to monthly)
Technology purpose	Controlled sustained release. Lowering the risk of adverse effects. Improve the stability in vivo.
Technology type	Linker, complex
Technology description	The uniqueness of this technology is based on self-cleaving linkers specifically designed to autohydrolyze at a predictable rate. Cleavage rates can be engineered to give an optimal pharmacokinetic. TransCon release kinetics are characterized by very low inter- and intra-patient variability. Albumin is a plasmaprotein which makes intravenous injection possible. The API is not cleared while it is conjugated to albumin, and is relaesed in a controlled manner during circulation for up to one month.

Name	**Camurus AB**
Description of organisation	Camurus' vision is to be the world leading provider of advanced drug delivery technologies and exploit these in the development of superior therapeutics.
Technology name	**FluidCrystal® Injection depot**
Patented	Yes
Status	Most advanced product using this technology is in Phase II
Delivery of	Proteins, peptides and small molecules

Therapeutic area	Cancers and other neoplasms, Behaviors and mental disorders, Hormone related diseases
Mode of administration	Injectable SC/IM
Technology purpose	To ensure sustained release and overcome the side effects associated with burst release. Injection of a small volume and less pain. Improve drug stability
Technology type	Depot, implant
Technology description	Camurus' FluidCrystal® depot formulation is injected as a low viscous liquid in which the drug compound is dissolved or suspended. After injection, the formulation absorbs interstitial water from the surrounding tissue, and a viscous liquid crystal controlled release matrix is generated. The rapid shell formation at the surface of the depot effectively encapsulates the drug, facilitating fast onset and low initial burst. Extended release of the active compound occurs during biodegradation of the depot, and can be tuned from days to months. Proteins and peptides are stabilized in the liquid crystalline environment where they are protected from endogenous enzymes. Low viscosity of permits the use of thin needles leading to less pain by injection. High solubilizing capacity allows small injection volumes
Technology name	**FluidCrystal® NP Injection nanoparticles**
Patented	Yes
Status	Most advanced products using technology is in preclinic
Delivery of	Proteins, peptides and small molecules
Therapeutic area	N/A
Mode of administration	Injectable IV
Technology purpose	Improve the dissolution of low solubility compound. Improve drug stability. Controlled release. Enhance systemic circulation
Technology type	Nanoparticles
Technology description	Camurus' FluidCrystal® NP delivery system is based on lipid nanoparticles comprising liquid crystal nanostructures. The curved lipid membrane interior of the particles features both hydrophilic and lipophilic domains. Because of these coexisting domains and an enormous surface area, the liquid crystal carriers have a broad spectrum of applicability, including therapeutic peptides and proteins. The delivery system has excellent solubilization capacity allowing for high drug payloads of amphiphilic, lipofilic and water insoluble compounds. High payloads enable small injection volumes. Proteins and peptides can be encapsulated in the nanostructured interior of the particles, and thereby be protected from rapid in vivo degradation by e.g. endogenous enzymes.
Technology name	**FluidCrystal® Topical bioadhesive**
Patented	Yes
Status	Marketed
Delivery of	Proteins, peptides and small molecules
Therapeutic area	Cancers and other neoplasms, mouth and tooth diseases
Mode of administration	Topical
Technology purpose	Lower the rate of clearence thereby increasing absorption of the drug. Sustained release. Protection of biosurfaces.
Technology type	Depot, implant

Technology description	Camurus' FluidCrystal® topical bioadhesive delivery system is broadly applicable to challenging drug compounds, including sparingly soluble small molecules and degradation sensitive compounds such as peptides and proteins. High solubilisation capacity allows for drug payloads up to 30% or more depending on physico-chemical properties of the API. The formulation is applied as a liquid lipid solution containing the dissolved drug substance. Following administration the formulation spreads over topical and mucosal surfaces and transforms in situ to a long-term stable bioadhesive, protective and encapsulating liquid crystalline film from which the drug is slowly released.
Technology name	**FluidCrystal® NP Transdermal nanoparticles**
Patented	N/A
Status	N/A
Delivery of	Peptides and small molecules
Therapeutic area	N/A
Mode of administration	Topical
Technology purpose	Enhance transdermal flux
Technology type	Nanoparticles
Technology description	The delivery system improves the bioavailability of small molecule drugs and peptides by facilitating high drug payload and efficient transport across the skin. The formulation is available as a dispersion of nanoparticles in a liquid or cream. Together with their high solubilizing capacity, the dispertions are phisically stable at very high particle concentrations, which allow for high drug payloads and an effective concentration gradient over the skin.
Technology name	**FluidCrystal® NP - Flexosome®**
Patented	Yes
Status	Most advanced product using this technology is in Phase II
Delivery of	Small molecules
Therapeutic area	N/A
Mode of administration	Oral
Technology purpose	Enhance bioavailability of sparingly soluble drugs. Controlled dispersion formation and drug release.
Technology type	Nanoparticles
Technology description	For sparingly water soluble small molecules, showing poor inherent gastrointestinal absorption, the bioavailability can be increased to almost complete absorption by using the Flexosome® carrier. It is specially designed to easily selfemulsify to submicron particles also at low aqueous content, and to carry high drug loads. Up to 30% loading capacity has been achieved for selected drug compounds.
Technology name	**FluidCrystal® NP - Cubosome®**
Patented	Yes
Status	Most advanced product using this technology is in Phase II
Delivery of	Proteins and peptides
Therapeutic area	N/A
Mode of administration	Oral

Technology purpose	Enhance bioavailability of sparingly soluble drugs. Controlled dispersion formation and drug release. Increased stability in vivo and increased absorption.
Technology type	Nanoparticles
Technology description	The Cubosome® carrier can effectively protect water-soluble peptides from enzymatic degradation. In preclinical studies bioavailability enhancements ranging from twenty to more than one hundred times have been demonstrated. This corresponds to absolute bioavailabilities between 1 to 10%. In an alternative application large proteins have been encapsulated for local activity in the gastrointestinal tract. Protein enzymes protected in the liquid crystal interior of the nanoparticles showed almost full activity since large endogenous degrading enzymes are sterically hindered to diffuse into the network while small molecule substrates can pass.

Name	**Egalet A/S**
Description of organisation	In line with Egalet a/s' therapeutic focus in Pain Management, Egalet a/s will develop its pipeline of opioid products for out-licensing on a global scale. In addition, Egalet a/s seeks to out-licence its delivery technologies to leading edge companies.
Technology name	**Egalat® Prolonged release**
Patented	Yes
Status	N/A
Delivery of	Small molecules
Therapeutic area	Nervous system diseases, Behavior and mental diseases
Mode of administration	Oral
Technology purpose	To ensure a constant rate of release, and to prolong the release at a controlled amount of time. To deliver water-insoluble compounds in a controlled manner.
Technology type	Coating, encapsulation, Modified release tablet
Technology description	The shell is biodegradable but with a disintegrating profile making the shell last longer than the matrix. The drug is distributed throughout the matrix, which is eroded by gut movements and gastrointestinal fluids as it passes through the gut. The matrix is designed to erode when in contact with available water but, at the same time, it is desirable that water does not diffuse into the matrix until the point of release. The entrapment in the Egalet® matrix also protects the active compounds from oxygen and humidity and therefore the technology is suited for chemically unstable substances and thus is able to increase shelf-life of the drug product. The rate of release can be altered by adjusting the composition of the polyethylene glycol (PEG) carrier within the matrix.
Technology name	**Egalat® Delayed release**
Patented	Yes
Status	N/A
Delivery of	Small molecules
Therapeutic area	Nervous system diseases, Behavior and mental diseases
Mode of administration	Oral
Technology purpose	To delay the release until a controlled time to mimic the natural rhythms of a disease. Furthermore to ensure a constant rate of release, and to prolong the release at a controlled amount of time. To deliver water insoluble compounds in

	a controlled manner.
Technology type	Coating, encapsulation, Modified release tablet
Technology description	The shell is biodegradable but with a disintegrating profile making the shell last longer than the matrix and the lag component. The drug is distributed throughout the inner layer of the matrix between the lag components, which are eroded by gut movements and gastrointestinal fluids as it passes through the gut. The matrix is designed to erode when in contact with available water but, at the same time, it is desirable that water does not diffuse into the matrix until the point of release. The rate of release can be altered by adjusting the composition of the polyethylene glycol (PEG) carrier within the matrix and adjusting the composition of the lag component.
Technology name	**Parvulet®**
Patented	Yes
Status	N/A
Delivery of	Small molecules
Therapeutic area	N/A
Mode of administration	Oral
Technology purpose	Easy to swallow for the child/elderly leading to improved compliance. Long stability compared to oral solutions.
Technology type	Other
Technology description	Drugs contained in the Parvulet® technology are dispensed as a dry powder or granules that on exposure to a small amount of water turns into a tasty, soft textured, “pudding like” mass in less than 15 seconds. The formulated drug can also be incorporated into a familiar carrier, such as a spoon, with the water being added just before administration.

Name	**Life Cycle Pharma A/S**
Description of organisation	LCP has a dual business model: 1) Enhancing generic APIs in a own product portfolio which includes products for immunosuppression, specifically organ transplantation, and products to combat certain cardiovascular diseases; 2) Using technology on consultancy basis for other companies. Very little focus on consultancy services.
Technology name	**MeltDose**
Patented	Yes
Status	Frst drug using Meltdose has been marketed
Delivery of	Small molecules
Therapeutic area	Immune system diseases, Digestive system diseases
Mode of administration	Oral
Technology purpose	To improve the dissolution of low soluble drugs.
Technology type	Solid dispersion
Technology description	The process patented as "Controlled Agglomeration" works by incorporating the drug substance with low water solubility into a "meltable" vehicle. The melt is solidified when deposed on the particle carrier, and thus captures the active drug in a solid dispersion. The particle size is then increased by controlling and optimizing the product temperature and feed rate of the melt. The granulate can

	be directly compressed into tablets without additional processing steps besides blending with a lubricant. In addition, the technology allows for customization of the release profile, to create various profiles. Once in tablet form, the dissolution profile and the particle size of drugs manufactured using MeltDose® technology remain stable allowing for a long shelf-life.

Name	Liplasome Pharma A/S
Description of organisation	Liplasome Pharma A/S focuses on the development of the targeted drug delivery platform for conventional chemotherapeutics. Development of the targeted prodrug delivery platform for a new class of anticancer drugs called anticancer lysolipids. The LiPlasome technology provides a liplasomal reformulation of the most used anticancer drugs on the market like Cispaltin -> LiPlaCis®, Oxaliplatin -> LiPloxa. The aim is to provide more effective treatment to cancer patients with fewer side effects.
Technology name	LiPlasomes
Patented	Yes
Status	LiPlasomes most advanced program I LiPlaCis® in a close escalating clinical phase I trial. In addition two programs are in pre-clinical development.
Delivery of	Small molecules. Peptides and nucleic acids at the formulation stage.
Therapeutic area	Cancers and other neoplasms
Mode of administration	Injectable IV
Technology purpose	Prolong serum half-life. Release of the drug or prodrug specifically at the tumor target site thus avoiding major site effects and accumulating the amount of drug around the target cells. It is posible to treat cancer without any knowledge of the position and size of the tumor.
Technology type	Nanoparticles
Technology description	The drug loaded lipid nanocarriers are designed to be particularly susceptible to degradation by phospholipase A2 (PLA2), which is upregulated in the tumor microenvironment of several cancer types. The carrier nanoparticles are composed of special prodrug lipids whose degradation products, after exposure to PLA2, are converted to active drugs such as anticancer lysolipids and/or fatty acid drug derivatives. The PLA2 hydrolysis products will furthermore act as locally generated permeability enhancers that promote the absorption of the released drugs across the cancer cell membranes into putative intracellular target sites.

Name	Magle AB
Description of organisation	DSM is Magle's area of key expertise and focus. Magle welcomes new development initiatives from industrial partners and are capable of developing ideas from conception through to full scale manufacturing under GMP conditions.
Technology name	Biodegradeble Starch Microsheres (DSM)
Patented	Yes
Status	Marketed
Delivery of	Small molecules, peptides, proteins, nucleic acids
Therapeutic area	Cancers and other neoplasms
Mode of administration	Injection IA (the hepatic artery) in the treatment of liver cancer. For controlled

	release applications e.g. nasal, buccal and parenteral.
Technology purpose	Enable local delivery of cytostatic drug in the treatment of liver cancer
Technology type	Coating, encapsulation
Technology description	Creating an osmotic pressure, the particles concentrate platelets and other blood constituents on their surfaces and as the blood becomes dehydrated, the hemostatic cascade kicks in. Magle's DSM-S is used as an adjuvant in the treatment of liver cancer. Put to work, a sterile DSM-S suspension is co-injected with the cytostatic drug in the hepatic artery, where the microspheres cause a temporary arterial occlusion and a high local concentration of the drug. The degradation of the DSM-S particles starts immediately and full resorption is reached within 60 minutes, completely restoring blood flow. Potential areas where DSM opportunities can be turned into commercial value are e.g. for controlled release.

Name	**Meabco A/S**
Description of organisation	Meabco A/S is a Biotech Company primarily focused on oncology and radiation protection. The company's products are based on combinations of BP-Cx-1and pharmaceutically active metal ions. The company is currently finalizing protocol for Phase 2, trial for its lead product, BP-C1, in breast cancer patients.
Technology name	**BP-Cx-1**
Patented	Yes
Status	Phase 2
Delivery of	Small molecules
Therapeutic area	Cancers and other neoplasms
Mode of administration	Injectable IV, SC, IM
Technology purpose	To facilitate the uptake of metal ions (the API) into cells. Reduced levels of the API are required to produce the therapeutic effect, thus reducing side effects.
Technology type	Linker, complex
Technology description	Meabco's BP-Cx-1 technology is capable of chelating/encapsulating the metal ions, and facilitates their uptake into cells. As a consequence, reduced levels of the API are needed to achieve the same therapeutic effect. Furthermore, BP-Cx-1 has immune stimulatory and detoxifying effects. The chelating effect of BP-Cx-1 and the reduced concentrations of API almost completely eliminate the known severe side effects of standard platinum-based drugs. It has been demonstrated that BP-Cx-1 promotes the transportation and accumulation of platinum in tumor tissues. The BP-Cx-1 drug, being non- toxic on its own can affect toxicity of other antitumor drugs, e.g. cis-platine, without reducing their efficacy.

Name	**Nordic Vaccine A/S**
Description of organisation	Nordic Vaccine A/S is a vaccine R&D company with focus on the development and commercialization of superior vaccines for prophylactic as well as therapeutic use. The company's development program is based on PosintroTM.
Technology name	**Posintro™**
Patented	Yes
Status	N/A

Delivery of	Antigen
Therapeutic area	Viral diseases
Mode of administration	Topical
Technology purpose	Protect the immunogens against in vivo degradation. Facilitate transport over skin and mucosal membranes in a non invasive manner. Improve efficiency of the delivery and adjuvant system.
Technology type	Nanoparticles
Technology description	The resulting Posintro™ platform is one of the most efficient delivery and adjuvant systems known today. The basic components are saponin derived from the Quillaja Saponaria tree, phosphatidyl-choline and cholesterol. Given the right conditions, these components assemble into a cage-like structure with an average diameter of 40-50nm. The structure and composition of Posintro™ allow the immunogen to be bound to the particle by a multitude of different mechanisms, e.g. electrostatic interaction by charge modification, incorporation of chelating groups or direct binding.
Technology name	**TransVac™**
Patented	Yes
Status	N/A
Delivery of	Antigen
Therapeutic area	Viral diseases
Mode of administration	Cutaneous
Technology purpose	Facilitate the delivery of the nanoparticles through the skin in a non invasive manner.
Technology type	Patch
Technology description	When placed on the skin, the TransVac™ patch allows the Posintro™ particles to penetrate the upper skin (stratum corneum) and deliver the vaccine antigen to the antigen presenting Langerhans cells in the epidermis. This activates the Langerhans cells, which migrate to the draining lymph node to proceed with the normal process establishing an immune response.

Name	**Novozymes A/S**
Description of organisation	Novozymes is world leader in bio-innovations and enzymes. The company's biopharmaceutical ingredients are proteins and other biological substances used in the pharmaceutical industry. Our proteins replace proteins from humans and animals that have traditionally been used and have posed the risk of transferring disease. Our proteins do not pose this risk and offer further advantages such as cost savings, process performance, consistency, and compliance.
Technology name	**rP-nano™**
Patented	Yes
Status	ND
Delivery of	Nucleic acid, protein (enzymes and antibodies), antigen, peptide, small molecules
Therapeutic area	Cancers and other neoplasms, Viral diseases
Mode of administration	Oral, topical
Technology purpose	Enable targeted delivery of biopharmaceuticals and enhance uptake across epithelium membranes and cell membranes thereby improve bioavailability.

Technology type	Nanoparticles
Technology description	The technology is jointly owned by Novozymes A/S and Upperton limited. rP-nano is a highly targeted drug delivery system which utilises the natural binding properties of recombinant protein nanoparticles to enhance bioavailability. The particles can be efficiently and densely loaded with APIs. The successful uptake of nanoparticles across membranes and cell surfaces depends on particle size. The technology can generate precisely-sized nanoparticles that can be optimized for enhanced permeability and retention effect. The nanoparticles produced through this process retain the natural binding properties of the recombinant proteins from which they are made, and bind to specific cell types to enable more targeted drug delivery and improved bioavailability.
Technology name	**Albucult®**
Patented	Yes
Status	Marketed
Delivery of	Peptides
Therapeutic area	N/A
Mode of administration	N/A
Technology purpose	Lower the administration frequency and enable targeted drug delivery. Improve device efficacy, and reduced risk of abrasion, adhesion, infection, and blood clotting.
Technology type	Nanoparticles
Technology description	Albucult® is recombinant albumin for drug, vaccine and device manufacturing. In drug manufacturing the albumin can extend the half life of peptides. Furtermore it enables targeting of the drug and specific delivery, and can be used to produce albumin micro- and nanoparticle-based drugs. In the production of medical devices albubin can be used for coating. Other application areas include IVF and advanced cell therapy media ingredient.
Technology name	**Albufuse®**
Patented	Yes
Status	Marketed
Delivery of	Proteins and peptides
Therapeutic area	N/A
Mode of administration	N/A
Technology purpose	Lower the administration frequency. Lower the dosage needed to produce a pharmacological response.
Technology type	Linker, complex
Technology description	Increased half-life of the active molecule, resulting in less frequent administration and increased bioavailability. Because of this high peak values are reduced thereby lowering the side effects. The tolerance of the drug is thus improved.
Technology name	**HyaCare**
Patented	Yes
Status	Marketed
Delivery of	Peptides, proteins and small molecules
Therapeutic area	N/A

Mode of administration	N/A
Technology purpose	Enable targeting, sustained release, improve stability in vivo. Improve the compliance and bioavailability for topical applications.
Technology type	Linker, complex
Technology description	HyaCare is the first hyaluronic acid produced without the use of animal-derived materials and organic solvents. Owing to its exceptional water-binding, visco-elastic and biological properties, HA adds new and improved attributes to formulations. When used for drug delivery, HA provides clear advantages such as stable drug formulations, effective drug targeting and receptor-mediated uptake. Furthermore HA exhibits significant structural, rheological, physiological and biological functions. HA is a polyanionic polymer that can form complexes with drugs and stabilize drug formulations. A relatively simple chemical structure allows HA to be further modified to create a wide range of possible drug delivery carriers. The polymer is non-toxic, non-immunogenic and biodegradable.
Technology name	**Recombumin®**
Patented	Yes
Status	Marketed
Delivery of	Proteins and peptides
Therapeutic area	N/A
Mode of administration	N/A
Technology purpose	Lower the administration frequency. Enable targeted drug delivery. Lower the dose needed to produce a pharmacological respons.
Technology type	Nanoparticles
Technology description	Recombumin® is recombinant albumin for drug and vaccine manufacturing. The albumin can extend the half life of peptides. Furtermore it enables targeting of the drug and specific delivery, and can be used to produce albumin micro- and nanoparticle-based drugs.

Name	**NsGene A/S**
Description of organisation	NsGene A/S develops novel biological products for the treatment of neurological disorders. The Company is an expert in transitioning human cell and gene based research to product development.
Technology name	**EC Biodelivery™**
Patented	N/A
Status	Most advanced product is in phase I
Delivery of	Protein
Therapeutic area	Nervous system diseases
Mode of administration	Other (surgery)
Technology purpose	To enable the penetration of the BBB by the API. To aim the delivery to a distinct anatomic area of the CNS. The technology offers great safety advantages over direct gene therapy approaches and technical and functional advantages over pump technologies.
Technology type	Depot, implant
Technology description	The EC BiodeliveryTM platform is a general biodelivery system of cell-derived substances to the CNS that provides a controlled, site-specific and safe delivery

	of a variety of therapeutic substances. The proprietary EC BiodeliveryTM system consists of a catheter-like device that in the active portion contains a genetically modified human cell line enclosed behind a semi-permeable hollow fiber membrane. The membrane allows for the influx of nutrients and outflow of the therapeutic factor(s) but does not allow for the direct contact between the therapeutic cells and the host tissue. The encapsulated cells provide for long-term (> 12 months) factor secretion from the implanted device.

Name	Santaris Pharma
Description of organisation	Santaris Pharma A/S uses their LNA Technology Platform combined with their Drug Discovery Engine to develop new oligonucleutide drug candidates.
Technology name	**Locked Nucleic Acid (LNA)**
Patented	Yes
Status	Most advanced product using the technology is in phase I
Delivery of	Nucleic acids
Therapeutic area	Cancers and other neoplasms, Viral infections
Mode of administration	Injectable IV
Technology purpose	Enable the delivery of high doses of oligonucleotides. Reduce the toxicity of the formulations. Improve the biostability.
Technology type	Compound engineering
Technology description	Therapeutic oligonucleotides can be designed to seek out and bind specifically to disease-related RNAs. Once bound, the RNA is degraded or rendered inactive, thereby ameliorating the diseased state. Chief amongst the properties of LNA are its high biostability and remarkable target affinity that in turn enables strong pharmacological activity to be packed into shorter-than-usual-oligonucleotides. When administered systemically, these oligonucleotides are delivered to a range of tissues where they elicit specific, potent and long lasting reduction of the RNA target. Most importantly, the strong pharmacology of LNA oligonucleotides is achieved without the complex and often toxic delivery formulations needed for delivery of the more complex structured double stranded siRNAs.

Name	StratoSphere Pharma AB
Description of organisation	The company's mission is to provide the StratoSphereHL™ technology to the global pharma and biotech industry, thereby accelerating and facilitating the development of safe and effective sustained release injectables for proteins, peptides and small molecule drugs.
Technology name	**StratoSphereHL™**
Patented	N/A
Status	N/A
Delivery of	Proteins, peptides and small molecules
Therapeutic area	N/A
Mode of administration	Injectable SC/IM
Technology purpose	Reduce the risk of burst effects. Improve the drug payloads. Improve in vivo stability
Technology type	Coating, encapsulation

Technology description	StratoSphereHL™ is a coated microsphere, with an inner core consisting of the API and a minor amount of a matrix forming excipient, and another excipient forming an outer coating. The inner one carries the drug, offering a mild and favourable environment both during manufacturing, storage and use, as well as an exceptionally high payload capacity. The outer one controls the release rate, through a predictable degradation process trigged and maintained by the interstitial aqueous environment in the s.c. or i.m. tissue into which the injection is made.

Name	**TikoMed AB**
Description of organisation	TikoMed is focused on development and commercialization of innovative treatment of auto- immune and inflammatory diseases and transplantation therapies. The company applies advances in innate immunology to identify mechanisms and develop new products.
Technology name	**BioChamber®**
Patented	N/A
Status	N/A
Delivery of	Proteins and peptides
Therapeutic area	Cancers and other neoplasms; Immune system diseases; Blood and lymph conditions
Mode of administration	Injectable SC/IM
Technology purpose	Reduce the risk of rejection and of tumours associated with implants. Provide optimal conditions for the encapsulated cells to survive long term, thereby enableling sustained release of proteins and peptides.
Technology type	Depot, implant
Technology description	The BioChamber® has been developed to effectively and safely deliver celltherapies for a variety of applications. It encapsulates cells, thereby avoiding rejection and tumour risk. At the same time it provides optimal conditions for the protein producing cells to survive long term. This is possible by combining materials and structures, promoting stability and integration thereby avoiding connective tissue formation. The BioChamber® has in studies documented close proximity of vessels to the chamber, making the transport of the therapeutic proteins to the human body possible. With the first generation of the BioChamber® TikoMed has documented a proof of concept (POC) with high delivery of the chosen protein.

Name	**TopoTarget A/S**
Description of organisation	TopoTarget (OMX: TOPO) is a biotech company dedicated to finding "Answers for cancer". The Company is focused on the development and commercialisation of improved treatments for cancer patients, and other cancer-related disorders. TopoTarget has a marketed product in both Europe and the US and a broad late stage clinical pipeline containing eight products.
Technology name	**MegaLigand™**
Patented	N/A
Status	Most advanced product using this technology is in phase I
Delivery of	Protein

Therapeutic area	Cancers and other neoplasms
Mode of administration	Injectable SC/IM
Technology purpose	To trigger apotosis by mimicking the clustering of TNF at the tumour cell surface.
Technology type	Linker, complex
Technology description	The MegaLigandTM technology couples the receptor-binding domain of members of the human TNF family with a protein backbone from another human protein to produce a hybrid fusion protein molecule optimised for interaction with the appropriate surface receptor. The protein backbone is typically a dimer from another unmodified human protein. Coupling naturally trimerising extracellular domains from TNF family members to a dimer produces a multimeric MegaLigand product that is designed to optimally activate the corresponding cell surface receptor. For example, the natural trimeric form of FasL is inactive, and is only rendered active by ligand clustering at the cell surface. The MegaLigand product mimicks this situation.

Name	**Zealand Pharma A/S**
Description of organisation	Zealand Pharma is a biopharmaceutical company dedicated to the discovery and development of innovative peptide-based drugs. The products target diseases and symptoms of significant unmet clinical need and commercial potential.
Technology name	**SIP®-technology**
Patented	Yes
Status	Most advanced product using the technology is in phase III
Delivery of	Peptides
Therapeutic area	Cancers and other neoplasms; Hormone related diseases; Heart and blood diseases; Muscle, bone and cartilage diseases; Nutritional and metabolic diseases; Digestive system diseases
Mode of administration	Injectable SC/IM
Technology purpose	To extend the half life of the peptides
Technology type	Compound engineering
Technology description	Zealand Pharma's SIP®-technology aims to enable the stabilization of peptides by preventing enzymatic digestion. Consequently, SIP®-modification of a peptide may also enhance the duration of action of a compound. In addition, Zealand Pharma's experience in synthetic chemistry enables the optimization of peptides with the goal of generating specific qualities, including for example, increased biological half-life and improved product stability.

Name	**Zgene A/S**
Description of organisation	Zgene's mission is to develop products based on a novel activatorsystem in combination with FDA approved cytotoxic drugs. Products are based on ZAS™.
Technology name	**ZAS™**
Patented	Yes
Status	N/A
Delivery of	Nucleic acids
Therapeutic area	Cancers and other neoplasms
Mode of administration	Injectable IV

Technology purpose	Improve the therapeutic efficiency of other cytotoxic drugs with the posibility of lowering the dose drug thus eliminating side effects. Target the therapeutic activity of cytotoxic drugs.
Technology type	Gene based targeting
Technology description	The ZAS™ platform technology combines novel genes and existing drugs. ZAS™ gene is based on ultra-fast, multisubstrate enzymes that can convert a variety of analogs used for treatment of cancer and viral diseases with much higher efficiency and specificity than human enzymes. The ZAS™ gene is the highly optimized and efficient deoxyribonucleosidekinase. 2-5 days after the ZAS™ gene has been administered the cytotoxic drug is given. The ZAS™ genes increase the toxicity of the particular drug by up to 20,000 fold, completely changing the pharmacological effect and application of these compounds.

6.2 Probiotic companies

Name	**Bifodan A/S**
Description of organisation	Bifodan is a specialized provider of innovative probiotic solutions to the pharmaceutical and dietary supplement industries.
Technology name	**ProTarget™**
Patented	Yes
Status	N/A
Delivery of	Viable microorganisms
Therapeutic area	Digestive system diseases
Mode of administration	Oral
Technology purpose	The purpose of the technology is to protect the bacteria from the gastric acid and the bile salts.
Technology type	Coating, encapsulation
Technology description	ProTarget™ is designed to protect the probiotics from gastric acid and bile salts and to target the release of viable probiotics throughout the digestive tract.

Name	**Biogaia AB**
Description of organisation	Swedish company, world leader in probiotics, that develops and sells probiotic products and solutions that promote people's health. Products combine the well researched probiotic bacteria Lactobacillus reuteri (L. reuteri) and top of the line engineering to develop one of a kind delivery systems that match consumer needs.
Technology name	**Probiotic straw**
Patented	N/A
Status	Marketed
Delivery of	Viable microorganisms
Therapeutic area	Digestive system diseases
Mode of administration	Oral
Technology purpose	To improve compliance

Technology type	Device
Technology description	The bacteria are present in the bottom of the straw. When liquid is sucked through the straw, the bacteria are released to the liquid and transported through the mouth to the GI.
Technology name	**LifeTop Cap**
Patented	N/A
Status	Marketed
Delivery of	Viable microorganisms
Therapeutic area	Digestive system diseases
Mode of administration	Oral
Technology purpose	To improve compliance
Technology type	Device
Technology description	The bacteria are present in the cap. When liquid runs through the cap, the bacteria are released to the liquid and transported through the mouth to the GI.

Name	**Cell Biotech Europe A/S**
Description of organisation	Cell Biotech is a young, Danish-Korean bio-venture company dedicated to probiotics. The company has developed and optained several patents for its unique dual coating technology, Duolac®.
Technology name	**Duolac™**
Patented	Yes
Status	Marketed
Delivery of	Viable microorganisms
Therapeutic area	Digestive system diseases
Mode of administration	Oral
Technology purpose	Improve gastric acid and bile tolerance.
Technology type	Coating, encapsulation
Technology description	When the dual-coated bacteria are in acidic conditions at around pH 4, their shell coating is tightening and becomes more protective, but this hold releases when the pH is raised to around 7. Thus, the protein-coating remains intact whilst they are in the stomach protecting the lactic acid bacteria against the gastric acid down to pH 2; and it is not until the pH is raised in the intestine to around pH 7, that the coating becomes soluble and the lactic acid bacteria are released. 2nd coating layer - consists of a polysaccharide & hydrocolloid matrix which increases stability during manufacture and shelf life of product.

Name	**Probi AB**
Description of organisation	Probi is a leading player in probiotics research and the development of efficient and well-documented probiotics. The research areas include: gastrointestinal tracts, immune system, metabolic syndrome and stress and recovery. Probi's customers are leading companies in the functional foods and dietary supplement business areas.
Technology name	**Technical applications**
Patented	ND

Status	ND
Delivery of	Viable microorganisms
Therapeutic area	Digestive system diseases
Mode of administration	Oral
Technology purpose	To improve stability during storage and in vivo. Furthermore to enable the delivery through functional food.
Technology type	Coating, encapsulation
Technology description	Probi is focusing on improving the shelf life for probiotics that are added to various food products. For cereals applications eg. microencapsulation is used. Probi's probiotics can survive at extremely low pH levels, meaning that they can survive in chilled fruit drinks and juices. Probiotics can be added directly to the tank after drinks are heat-treated, or added aseptically in the filling line. For the production of dietary supplements containing probiotics, Probi can supply probiotics in the form of capsules, tablets, sticks or sachets. Shelf life is about 24 months at room temperature, depending on the product.

6.3 Contract Organisations

Name	**Active Biotech AB**
Description of organisation	Active Biotech focuses on developing pharmaceuticals for medical fields in which the immune system plays a central role. The portfolio includes innovative substances that modulate the immune system. Most progress has been made in developing products designed to treat multiple sclerosis, as well as lung, renal and pancreatic cancer. Furthermore Active Biotech AB has contract research activities.
Area of expertise	**Formulations**
Delivery of	Small molecules
Mode of administration	ND
Technology purpose	To develop formulations of pharmaceutical compounds for use in preclinical studies
Technology type	Formulation development
Technology description	Active Biotech AB can develop and manufacture formulations of Pharmaceutical compounds for use in preclinical studies. Formulations for in-vivo use are normally suspensions or aqueous solutions but with experience in co-solvents, PEG's and cyclodextrins. Determination of physic-chemical characteristics (solubility, log P and pKa) are an integral part of the formulation development.

Name	**Bioglan AB**
Description of organisation	Bioglan AB is a contract development and manufacturing organisation with more than twenty-five years of experience in research, development, manufacturing and marketing of pharmaceuticals.
Area of expertise	**Topical formulation services**
Delivery of	Small molecules
Mode of administration	Topical, injection, nasal
Purpose of service	Optimize drug delivery

Technology type	Formulation development; Inhaler aerosol
Technology description	Bioglan count many years of experience in formulation development and in particular development of semi-solid and liquid pharmaceutical products for topical use. Cooperation within development projects has extended the knowledge into other areas such as injection and nasal products. In addition to improvement of the stability and cosmetic properties of the formulation, drug delivery is also optimized.

Name	**Bioneer A/S**
Description of organisation	Bioneer is a contract research organisation focusing at the early development phase of new pharmaceutics.
Area of expertise	**Targeted delivery**
Delivery of	Small molecules
Mode of administration	Injectable SC/IM
Purpose of service	Increase efficacy and reduce side effects by targeted delivery.
Technology type	Liposome
Technology description	The goal is to develop new ways of delivering therapeutics in a localised fashion at a site of disease. This is done by innovative liposomal delivery techniques.

Name	**Bioperm AB**
Description of organisation	Bioperm AB was established as a contract research organization in 1998. The company has developed new research tools to deliver drug to predefined sites in the human gastrointestinal tract.
Area of expertise	**Studies of local delivery in the gastrointestinal tract**
Delivery of	Small molecules
Mode of administration	Oral
Purpose of service	Evaluate the local delivery of an API in the gastrointestinal tract
Technology type	Coating, encapsulation; Liposomes
Technology description	The method involves swallowing of a small plastic capsule which, while being moved by peristalsis, pulls a thin soft tube to the intended location in the human gut. The thin tube is inserted into and attached to a metal tube (X-ray visible). Hence an open line to any location in the gastrointestinal tract, even the distal colon, is created. At the intended destination, the capsule is stopped by fixating the tube to the cheek of the subject. Drug solution may then be administered as a bolus dose by a syringe or as a continuous infusion by a pump. With a modification of the capsule, powder or other solid formulations may be administered. The exact position in the gut can be verified by fluorimetry or by injecting a gamma-emitting isotope for visualization with a gamma camera.

Name	**Chempilots A/S**
Description of organisation	Chempilots is a specialist in polymer chemistry and polymer process technology. We provide contract R&D, process development and production to the medical device and pharmaceutical industries.
Area of expertise	**Controlled drug release**
Delivery of	Small molecules

Mode of administration	N/A
Purpose of service	Establish zero-order release rates. Reduce the administration frequency and lower the side effects.
Technology type	Formulation development; Modified release tablets; Patch
Technology description	Chempilots has extensive experience in the development of polymeric systems for transporting and releasing substances under specific conditions. These include: Synthesis of nitrogen-monooxide-loaded polymers, and formulation of polymeric coating systems to obtain NO-release profiles applicable for less invasive cardio-vascular procedures. Development of implantable hydrogels with release profiles of anti-septic and anti-biotic agents. Formulation of mousse in pressurized canisters for transdermal delivery of steroids in the treatment of psoriasis and other skin diseases. Bioneer also has experience in bioadhesive polymers that enable dermatological patches for controlled drug release

Name	**Galenica AB**
Description of organisation	Galenica is a pharmaceutical technology CRO. Galenica can assist within all phases of a project, from the identification of an efficacious substance until a complete pharmaceutical is in commercial production. Galenica offers – preformulation and formulation, analysis, stability studies, documentation (CMC), GMP production of clinical trial material and project management.
Area of expertise	**Supporting formulation development and validation**
Delivery of	Small molecules, peptides, proteins and to a lesser degree vaccines and microorganisms.
Mode of administration	N/A
Purpose of service	To design appropriate formulations based on existing dosage forms
Technology type	Formulation development; Modified release tablets
Technology description	Galenica's core competence is drug development for the pharmaceutical industry. Their expertise is in pharmaceutical and analytical development/validation, and production of Clinical Trial Material (CTM) for Phase I-III. The company has broad skills and experience in development projects and manufacturing of pharmaceutical preparations, comprising the most common types of dosage forms. Non-traditional dosage forms include medicated shampoos and chewing gums.

Name	**Genovis AB**
Description of organisation	Genovis' business concept is to develop, produce, and market innovative technologies based on unique nanostructures which can enable new discoveries and make them easier and faster in the hands of researchers in the global life sciences industry.
Technology name	**NIMT® FeOdots**
Delivery of	Nucleic acids, peptides
Mode of administration	ND
Purpose of service	Enable targeted delivery of APIs with low stability in vivo. Enable the imaging and thereby the verification of the cluster side of the nanoparticles.
Technology type	Nanoparticles
Technology description	Genovis designs and produces nanoparticles for in vitro and in vivo delivery of

	peptides, small RNA and DNA. The nanoparticles are built up from inside and out starting with an oxide core, which in addition to making the particles stable makes them visible as contrast agent in MRI for dual delivery/imaging purposes. The coating or surface layer of the particle is biocompatible and provide colloidal stability. The coating material can vary depending on application and cargo molecules and each particle can carry multiple cargo molecules. In addition it is possible to attach ligands such as antibodies for targeting purposes.

Name	Qpharma AB
Description of organisation	QPharma is a complete contract developer and manufacturer of pharmaceuticals.
Area of expertise	Solid dosage products
Delivery of	Small molecules
Mode of administration	Oral
Purpose of service	To enable controlled release of the API, protect the API through the gastro intestinal tract and/or differentiate the product from other products.
Technology type	Formulation development; Modified release tablets
Technology description	QPharma offers virtually any form of solid dosage delivery system, including: Immediate-release film and non-coated tablets, controlled-release tablets (through core matrices or coating), effervescent tablets, hard 2-piece gelatin capsules, granules (immediate or controlled release), gums, lozenges, orally-disintegrating tablets (ODT)
Area of expertise	Polymeric controlled release systems
Delivery of	Small molecules
Mode of administration	Other
Purpose of service	Enable controlled release of the API over an extended period of time either locally or systemically. Lower side effects and improve compliance.
Technology type	Formulation development; Depot, implant
Technology description	QPharma has pioneered this technology and has an unparalleled track record when it comes to developing, transferring and manufacturing polymeric controlled-release systems. Our experience includes intra-vaginal rings (IVR) and intra-uterine systems (IUS) – the principles of which we are also bringing to subcutaneous implant delivery systems. The advantages include: Lower-dose substance delivery, reducing side effects and costs, a high degree of convenience for patients, and brand protection.

Name	Rechon Life Science AB
Description of organisation	The company focus on transformation of customer's technologies and formulations into validated, approved pharmaceuticals and medical products.
Area of expertise	Aseptic and spray production
Delivery of	Biologicals and small molecules
Mode of administration	Nasal and Oral
Purpose of service	Produce safe aseptic products and enable nasal administration
Technology type	Formulation development; Aerosols
Technology description	Aseptic production of vials and ampoules is performed in high-speed lines that include an ultra-sonic rinsing machine and hot laminar air-flow tunnel, as well as

	filling and sealing machines. Production of nasal and oral sprays takes place in high-speed lines that incorporate ultra-sonic rinsing, hot laminar air treatment, weight check, and sealing with pump or actuator.

Name	Recipharm
Description of organisation	Recipharm is mainly a contract development and manufacturing organisation. Beside from this recombinant proteins and mABs are also developed and manufactured.
Area of expertise	Formulation development services
Delivery of	Proteins, peptides and small molecules
Mode of administration	N/A
Purpose of service	Improve the properties of the formulation regarding physical properties and drug release etc.
Technology type	Formulation development; Patch; Coating, encapsulation; Modified release tablets
Technology description	Different dosage forms are available: Liquids; oral and topical, suspensions and emulsions. Semi-solids such as gels, controlled release gels, ointments, creams and suppositories. Pharmaceutical patches. Powders and granules. Capsules, coated capsules, capsules filled with un-coated or coated particles. Tablets, immediate-release tablets, coated tablets, enteric-coated tablets, sustained release tablets, tablets with active substance(s) in different layers. Parenterals and other sterile products.

6.4 Medtech

Name	Bang & Olufsen Medicon A/S
Description of organisation	B&O Medicon acts as a consultant to Pharmaceutical clients and business partners in the design and development phase of products
Technology name	Asmair®
Patented	N/A
Status	Prototype
Delivery of	Small molecules
Therapeutic area	Respiratory diseases
Mode of administration	Pulmonal
Technology purpose	To prevent under- and overcounting. Enable the use by elderly and children. Improve compliance
Technology type	Inhaler, aerosol
Technology description	This is a final stage prototype inhaler with a fully integrated single dose counter that provides clear guidance to the user. The device prevents undercounting helping patients understand their treatment regimes. The device also helps prevent overcounting helping patients remain in control of their dosage. With the counter monitoring exact dosing, the patient can for the first time rely directly on the dose counter to see how much medication or dosage remains. Another key feature is that there is 50 % less force required to release a dose when compared with normal inhaler- easy-to-use design for the elderly and

	children. The reusable cap reminds patients to take their dose and gives feedback to the patient on actual compliance level.
Technology name	**Insulair®**
Patented	No
Status	Developed
Delivery of	Peptides
Therapeutic area	Hormone related diseases
Mode of administration	Pulmonal
Technology purpose	To enable pulmonal delivery in systemic treatment with insulin and other biotech drugs. Safety is improved.
Technology type	Inhaler, aerosol
Technology description	Recently, more new and proven drugs are being prepared and formulated for use in a pressurized metered dose inhaler (pMDI).There is an increasing demand for a convenient pMDI inhaler solution for the treatment of Diabetics with insulin and for new Bio-tech drugs. This shift in treatment patterns is largely due to the technological maturing of the pMDI inhaler to administer systemic drugs through the lungs. Secondly, that the majority of patients prefer to use inhalers over other methods of drug delivery such as injection.
Technology name	**Leva®**
Patented	Yes
Status	Developed
Delivery of	N/A
Therapeutic area	N/A
Mode of administration	Injectable IV
Technology purpose	Improve safety. Easy to use.
Technology type	Injector
Technology description	LEVA®, a next generation auto injector that takes ease of use and safety to a higher level. A unique combination of key functionalities, intuitive design and few user steps provides a fast and easy path way to injection. The key functionalities include: Automatic needle retraction, skin sensor to avoid unintended dose release, few user steps, and an inspection window for easy dose conformation.
Technology name	**Dual-Chamber Technology**
Patented	Yes
Status	Developed
Delivery of	N/A
Therapeutic area	N/A
Mode of administration	Injectable IV
Technology purpose	Improve patient convenience and safety.
Technology type	Injector
Technology description	The demand for safe and easy to use injection devices continues to grow. This also includes the market for lyophilized products where a reconstitution process is required to create an injectable solution prior to injection. This can be a very complex process for the patient as it requires many preparation steps prior to injecting the drug. Based on user studies, interviews and surveys B&O Medicom

	has developed different concepts for reconstitution devices. The concepts are based on dual-chamber technology and aim to provide ease of use, safety and patient convenience through automation and an absolute minimum of user steps.

Name	BioModics
Description of organisation	Biomodics is an independent service and technology provider to the life science industry. Our vision is to be the leading innovator within diagnostics and health care devices.
Technology name	BioModics silicone drug-device solution
Patented	Yes
Status	Available
Delivery of	Small molecules, peptides
Therapeutic area	N/A
Mode of administration	N/A
Technology purpose	To enable sustained release for months with a controllable release profile. To enable the use of complex shaped medical devices as drug delivery devices.
Technology type	Depot, Implant
Technology description	BioModics Drug Delivery solutions incorporate water absorbing polymers in the silicone device, which creates a silicone hydro gel. The silicone hydro gel exhibits an unprecedented long term controlled drug release. Complex shaped silicone medical devices can be turned into drug delivery devices. Silicone rubber has found its use due to desirable properties such as chemical inertness and high flexibility. However, due to its hydrophobic nature the drugs that can be released are rather limited. BioModics' approach is to produce interpenetration polymer networks (IPNs) of silicone rubber and hydro gel material in supercritical carbon dioxide (scCO2). The novel technique enhances the material characteristics of silicone rubber by applying the unique properties of scCO2 as a solvent to bring new compounds inside the silicone rubber matrix. The IPNs are characterised by that cross-linked polymer is swollen with a monomer, followed by polymerization and cross-linking of the monomer. Super critical CO2 is used as a solvent and facilitates the combination of the IPNs and silicone into novel composite materials. The polymer incorporated in the Silicone Hydro gel IPN material absorbs water and facilitate the drug release.

Name	Clinova medical AB
Description of organisation	Clinova medical AB is based on the maxin technology
Technology name	Maxin
Patented	N/A
Status	Developed
Delivery of	Small molecules
Therapeutic area	Respiratory diseases
Mode of administration	Pulmonal
Technology purpose	To deliver the API periferily in the lungs
Technology type	Inhaler, aerosol

Technology description	When using the nebulizer multiple inhalations of the aerosol is possible. This increases the efficiency because multiple doses with low output lowers the risk of drops bigger than 5 µm. Drops this big will not travel to the periphery regions of the lungs. Nebulizers are usualy used at the hospitals due to their size, but maxin can be used at home.

Name	**Codan Steritex ApS**
Description of organisation	The main focus of Codan Steritex ApS is developing IV devices without the use of DEHP eg.
Technology name	**SWAN-LOCK®**
Patented	Yes
Status	Marketed
Delivery of	Small molecules
Therapeutic area	N/A
Mode of administration	Injectable IV
Technology purpose	Improve safety and reduce the risk of infections. Enable administration of multiple doses at the same spot.
Technology type	Needle Free Injection
Technology description	The SWAN-LOCK® enables easy addition and removal of fluids, is simple to handle and provides a secure, effective infection barrier, reducing the risk of infection to the patient or nursing staff. The SWAN-LOCK® adaptor has a priming volume of only 0.09ml, enabling precise dosage. The valve mechanism in the SWAN-LOCK® adaptor automatically opens when a syringe is connected. On removing the syringe, the connection automatically closes. This results in a completely closed system, preventing the escape of blood, fluid or the entry of air. The adaptor's male connector guarantees a safe connection to catheters, stopcocks or other female Luer Lock adaptors. The specific design of the SWAN-LOCK® gives low flow reduction (<16%), thereby achieving improved flow rates over similar systems on the market. The SWAN-LOCK® is latex-free and PVC-free, and is MRI compatible.

Name	**Emunio ApS**
Description of organisation	Emunio ApS focuses on implementing their reuse prevention technology in the health care sector in developing countries.
Technology name	**CADY**
Patented	Yes
Status	Marketed
Delivery of	Antigen
Therapeutic area	Viral diseases
Mode of administration	Injectable SC/IM
Technology purpose	To eliminate the risk of reuse of the syringe and thereby reducing the risk of infections with HIV, hepatitis B etc.
Technology type	Injector
Technology description	CADY is Emunio's 0.5ml AD syringe with integrated 23Gx1 needle for immunization purposes. It is suitable for mass immunization campaigns, and for

	use in health care clinics. CADY has a built-in mechanism designed to give a single dose of vaccine after which the syringe is permanently disabled. Thus, it prevents reuse of the contaminated syringes and eliminates unauthorized packaging, resale or reuse of the syringe. It is inexpensive, easy-to-use in a single-hand injection process, environmentally-friendly (PVC free, Latex free). By subsequent disposal, CADY is suitable for use is syringe melters, recycling or for incineration. CADY meets the new ISO 7886-3 standard for AD syringes.
Technology name	**Becky**
Patented	Yes
Status	Marketed
Delivery of	Antigen, Protein, peptides, mAB, nucleutides, small molecules
Therapeutic area	Viral diseases
Mode of administration	Injectable IV
Technology purpose	To eliminate the risk of reuse of the syringe and thereby reducing the risk of infections with HIV, hepatitis B etc.
Technology type	Injector
Technology description	Reuse-Prevention Feature (RPF) syringes have an integrated disabling mechanism to be engaged by the health care worker upon completion of the injection, and thus using this type of syringe prevents unintended reuse or resale after disposal. BECKY is Emunio's RPF syringe for curative purposes available in the sizes 2ml, 3ml, 5ml and 10ml with various needle sizes. It is suitable for use in hospitals and in health care clinics and may be used for bundling with pharma products. BECKY functions as a disposable syringe. However, it has a built-in mechanism designed to discourage reuse of the contaminated syringes. It is affordable, easy-to-use, environmentally- friendly (PVC free, Latex free). By subsequent disposal, BECKY is suitable for use is syringe melters, recycling or for incineration. BECKY meets the impending ISO 7886-4 standard for safety syringes.

Name	**Laccure AB**
Description of organisation	Laccure AB intends to bring their product through all necessary requirements and then sell the product in its entirety to an industrial partner for further commercialization.
Technology name	**Laccure**
Patented	Yes
Status	Under development
Delivery of	Small molecules (lactic acid)
Therapeutic area	Bacterial vaginosis
Mode of administration	Vaginal
Technology purpose	To develop a non-smear formulation for sustained release of lactic acid
Technology type	Depot/Implant
Technology description	Laccure is developing a new product for use in the treatment of Bacterial Vaginosis (BV), based on a proprietary substance that releases lactic acid to establish a physiologically low vaginal pH in BV patients. The product will quickly normalise vaginal pH and help keep it normal for a prolonged period of time, optimally one week per dosing. The substance released is identical to

	physiological lactic acid, which means it can be safely used as often as needed. In addition, the focus is on developing a user-friendly non-smear product which is easy to insert. The product will be developed as a medical device, with claims initially relating to pH regulation. Pharmaceutical pre-formulation work has been completed, including tests of release properties, pH-decrease and mucoadhesiveness.

Name	NoLabs AB
Description of organisation	NOLabs is a medical device company that intends to become the world leader in diabetes neuropathy related pain control. The company was founded in 2004 and is located in Helsingborg in the southern Sweden.
Technology name	NitroSense® Technology
Patented	Yes
Status	Marketed
Delivery of	Small molecules (nitric oxide)
Therapeutic area	
Mode of administration	Topical (patch)
Technology purpose	To enable effective local therapy and sustained release.
Technology type	Linker, complex
Technology description	The NitroSense Technology is adaptable and can be integrated in several tailor-made products, to ensure NO delivery to the right place at the right time in the right amount. Possible dosage forms include powder, tablets, suspensions and solutions, dressings and patches, and electrospun nanofibers. The NitroSense system does not need to be metabolized in the body to release NO. It starts to release NO when it comes in contact with the activation agent. No undesired or undefined cleavage products are produced. The technology allows for the release of a well-defined range of doses of NO in its purest form from dermatological patches and other devices. NitroSense Technology enables high but strictly local concentrations of NO. NitroSense Technology combines a highly potent material with an innovative delivery system, allowing a controlled and long-lasting release. Even if NO has a half life of only a few seconds under normal ambient conditions, the unique sustained-release technology permits continuous release for several hours, even days, depending on the delivery system. The short lifetime of nitric oxide combined with the design of our innovative delivery system makes local delivery possible. The exposure can be targeted to the area where the positive actions of nitric oxide are best benefited from.

Name	Union Medico ApS
Description of organisation	Biogen Idec has chosen to use Personal injector together with Avonex.
Technology name	Personal Injector
Patented	Yes
Status	Marketed
Delivery of	Small molecules
Therapeutic area	Immune system diseases
Mode of administration	Injectable SC/IM

Technology purpose	Reduce the fear and pain associated with injections. Improve the precision and safety of the injections and make it usable for persons with a minimum degree of functionality
Technology type	Injector
Technology description	Still more people contract diseases whose treatment requires delivery of drugs by injection daily or weekly. Personal injector enables the drug to be injected slowly, virtually eliminating the physical discomfort of injection. Personal Injector is designed as an attractive tool with which the user quickly becomes familiar. The injector minimizes the patient's fear of needles and substantially reduces the pain otherwise associated with managing injections. Anyone can use it including persons with a minimum degree of functionality. It furthermore improves precision and safety while administering intramuscular or subcutaneous injections.

Name	**William Cook Europe ApS**
Type of organisation	Medtech
Technology name	**Zilver® PTX® Drug-Eluting Peripheral Stent**
Patented	Yes
Status	ND
Delivery of	Small molecules
Therapeutic area	Heart and blood diseases
Mode of administration	Surgery
Technology purpose	To reduce need for leg amputations and bypass surgery
Technology type	Stent
Technology description	In a breakthrough development that could dramatically reduce the number of leg amputations and painful bypass graft surgeries performed annually, a first-of-its kind drug-eluting stent for a widespread form of peripheral arterial disease (PAD) is now available. The Zilver PTX stent has been shown to effectively bridge the gap between the patient results achieved by using open surgical bypass graft procedure and the earlier minimally invasive treatment options such as balloon angioplasty and bare metal stents. The Zilver PTX stent can be used to treat PAD in the superficial femoral artery, where it first expands and holds open the artery to restore blood flow. The device then delivers the drug paclitaxel to the cells in the vessel wall to reduce the risk of new blockages forming. In a major advance over previous drug-eluting technologies, the Zilver PTX achieves targeted drug delivery without using a polymer to adhere the drug to the stent body. This eliminates the potential patient risks associated with polymer-coated devices, including clot formation and inflammation.

6.5 Pharmaceutical companies

Name	**ALK A/S**
Description of organisation	ALK is a research-driven global pharmaceutical company focusing on allergy treatment, prevention and diagnosis. The mission is to improve the quality of life of persons with allergy by developing pharmaceutical products that target the actual cause of allergy. ALK is the world leader in allergy vaccination.

Product name	GRAZAX®
Delivery of	Small molecules
Therapeutic area	Immune system diseases
Product description	GRAZAX® is produced as an oral lyophilisate – a freeze-dried tablet. GRAZAX® is a fast-dissolving tablet that melts under the tongue within seconds. The immune system is the target for the pharmacodynamic effect of GRAZAX®. The aim is to induce an immune response against the grass pollen allergens with which the patient is treated. It has been clearly demonstrated that treatment with GRAZAX® induces a systemic competitive antibody response towards grass, for example in specific IgG, which prevent the binding between IgE and the allergen that would otherwise lead the allergic response.

Name	AstraZeneca
Description of organisation	Still waiting for data
Delivery of	
Therapeutic area	
Technology description	

Name	DuoCort AB
Description of organisation	DuoCort AB, founded by researchers at Gothenburg and Uppsala Universities, is leading the development of the first truly once-daily hydrocortisone tablet for adrenal insufficiency. The company is located in Helsingborg.
Technology name	DuoCort hydrocortisone dual-release tablet
Delivery of	Small molecules
Therapeutic area	Hormone related disorders
Technology description	By achieving quick onset followed by an extended release over the day, the DuoCort dual-release tablet will quickly after waking give the patient the high morning levels that naturally occur, the declining levels needed over the rest of the day, and a cortisol-free interval at night – thus closely mimicking the natural biological rhythm of cortisol. The DuoCort tablet will give physicians more flexibility in dosing and enable them to reduce doses in some cases, thereby reducing the risk of serious, long-term side-effects from chronic over-dosing. The basic release requirements are, for the immediate release part, a maximum peak concentration in blood after about 20-40 minutes, roughly equivalent to the morning dose of hydrocortisone that is used today. The extended-release part provides a continuous gradually declining release over 12-16 hours instead of the peaks and troughs now delivered by the second and third daily doses of conventional tablets Finally, the DuoCort profile delivers a cortisol-free interval during the night, thus mimicking the physiological release profile. The DuoCort hydrocortisone dual-release tablet is patent-protected and Orphan Drug designated.

Name	Ferring Pharmaceuticals A/S
Description of organisation	Ferring Pharmaceuticals is a research-driven biopharmaceutical company devoted to identifying, developing and marketing innovative products in the fields of reproductive health, urology, gastroenterology, endocrinology and

	osteoarthritis.
Research area	**Drug Delivery**
Delivery of	Peptides, small molecules
Therapeutic area	Hormone related diseases, Digestive system diseases, Muscle, bone, and cartilage disease
Research description	The preferred oral delivery systems are a plain tablet, capsule or granulate. Ferring's expertise does not only cover these, but also modified/sustained and instant release forms. Ferring works within areas like melt/freeze drying technologies, liquid capsules and pH independent release technologies. Besides rectal, vaginal and nasal delivery technologies, Ferring also focuses on small volume parenterals, i.e. injections. Ferring has developed a broad range of products for subcutaneous, intramuscular and intravenous injections. The formulations include delivery systems from simple injection solutions to a freeze drying powder to be reconstituted before use. For patients undergoing long term treatment, Ferring has developed technologies to exert a controlled release, for example micro-encapsulation or a self-forming depot. Ferring has expanded further into not only needle free devices, but also specific trans-dermal delivery technologies to ease convenience and user friendliness for the patient.

Name	**LEO Pharma A/S**
Description of organisation	LEO Pharma is a leading global pharmaceutical company specialising in dermatology and critical care. Leo Pharma has two research projects, which are both carried out in collaboration with the Faculty of Pharmaceutical Sciences, University of Copenhagen.
Research area	**Solid Liquid Nanoparticles**
Delivery of	Small molecules
Therapeutic area	Skin and connective tissue diseases, Immune system diseases
Research description	The object is to investigate the potential of solid liquid nanoparticles as drug delivery system in cutaneous treatment of atopic dermatitis in comparison with traditional and conventional cuteneous delivery systems. Skin permeation in vitro, in vivo effect in an animal dermatitis model, vehicle tolerability and physicochemical characteristics of the particles etc. will form the basis of the evaluation of the solid liquid nanoparticles.
Research area	**Dermal Drug Delivery**
Delivery of	Small molecules
Therapeutic area	Skin and connective tissue diseases, Immune system diseases
Research description	The overall aim is to develop an integrin-targeted liposome-based dermal drug delivery system for the successful delivery of an API to the target site in the skin. The delivery system will be used for the treatment of inflammation related skin diseases e.g. psoriasis. Nano size liposomes are used to increase penetration of the API into both intact and diseased skin. Ligands for the integrin are conjugated to the surface of the liposomes to target the proliferating target cells in the epidermis and thereby give a more specific delivery of the API.

Name	**LIDDS AB**
Description of organisation	LIDDS (Local Implant Drug Delivery System) is a Swedish life sciences company

	developing innovative pharmaceutical products based on its proprietary drug delivery technology.
Technology name	**Liproca®**
Delivery of	Small molecules
Therapeutic area	Cancers and other neoplasms
Technology description	Liproca® a micro particular, ceramic-based matrix containing the API. It is a novel bioresorbable, biocompatible and locally implantable controlled release formulation. Local delivery of controlled release formulations enables a high steady state concentration at the site of action for a prolonged period of time and thus higher efficacy, combined with a low systemic concentration thus reducing risk of adverse effects and drug interactions. The drug release rate can be modified from weeks to months, which will improve compliance by reducing the dosing frequency. The ceramic material will also make it possible to increase the accuracy in dose-positioning since the injected material will be visible with ultrasound. The technology platform has several potential applications as the carrier material can encapsulate various types of drugs

Name	**H. Lundbeck A/S**
Description of organisation	Lundbeck engage in research to find new drugs for treatment of CNS disorders, includ-ing depression, schizophrenia, Alzheimer's disease, Parkinson's disease, Huntington's disease, epilepsy and insomnia.
Research area	**Solid Dispersion**
Delivery of	Small molecules
Therapeutic area	Behaviors and mental disorders, nervous system diseases
Research description	The object is to characterize solid dispersions as carrier systems for poorly soluble drugs. Solid dispersions are characterized by the drug substance being solubilized into a semi-solid carrier which improves the oral absorption of the drug. It is essential to characterize in which physical state the drug is present in the solid dispersion. This includes methods for characterizing crystal form, particle size and detection the part of the drug being dispersed on molecular level in the matrix. The project includes development of in-vitro dissolution methods and in-vivo absorption studies. Lundbeck is member of the Prediction Drug Absorption Consortium, University of Copenhagen, Faculty of Pharmaceutical Science and Bioneer A/S.
Research area	**Modified Release**
Delivery of	Small molecules
Therapeutic area	Behaviors and mental disorders, nervous system diseases
Research description	Oral modified release is intended to deliver the API by a defined release profile. The object of the project is to develop standard modified release formulations to be applicable to a broad dose range and drug substances with different aqueous solubility. The drug delivery systems include matrix systems based on swelling polymers and mini-tablets for membrane controlled release.

Name	**McNeil Sweden**
Description of organisation	Research and development in McNeil is Johnson and Johnson's global center for research and development of Nicorette®. Smoking cessation products for the global OTC market is developed in Helsingborg, while a smaller unit in Lund is

	responsible for the clinical studies.
Product name	**NICORETTE® Gum**
Delivery of	Small molecules
Therapeutic area	N/A
Product description	The gum is available with different tastes and with two different amounts of nicotine. While chewing, the gum releases nicotine which is absorbed through the buccal mucosa. In case of excess chewing part of the nicotine will pass to the ventricle where the absorption is much lower. The effect of the gum sets of after five minutes of chewing, and after half an hour, the release of nicotine from the gum ceases.
Product name	**NICORETTE® Invisi Nicotine Patch**
Delivery of	Small molecules
Therapeutic area	N/A
Product description	This is the only patch available with 25 mg nicotine, but also 15 mg and 10 mg are available. The patch is almost invisible and designed so that it mimics nicotine concentrations over time after smoking. After 16 hours the amount of nicotine delivered is negligible. The nicotine is absorbed through the skin and enables a steady state concentration of nicotine in blood throughout the day.
Product name	**NICORETTE® Microtab**
Delivery of	Small molecules
Therapeutic area	N/A
Product description	The small lozenges are designed to dissolve slowly in the mouth to alleviate the symptoms without giving the burst effect associated with smoking a cigarette. The nicotine is absorbed through the buccal mucosa. In case of an accidental swallowing of a tablet, the amount of nicotine absorbed from the gut is much lower than from the buccal cavity.
Product name	**NICORETTE® Inhaler**
Delivery of	Small molecules
Therapeutic area	N/A
Product description	The shape and size of the inhaler is similar to that of a cigarette, and the use mimics that of smoking. When air is inhaled through the inhaler, a small amount of nicotine is released which is absorbed through the buccal mucosa.
Product name	**NICORETTE® Nasal Spray**
Delivery of	Small molecules
Therapeutic area	Nicotine replacement therapy
Product description	The nicotine delivered through the nasal spray is absorbed through the nasal mucosa. The absorption rate is fast though slower than in cigarette smoking.

Name	**Niconovum AB**
Description of organisation	Niconovum believe that there is a market for a range of nicotine replacement therapy products that will deliver nicotine more quickly and effectively than those currently available, thereby giving the consumer a perceived better control of cravings.
Product name	**Zonnic® Pouch**
Delivery of	Small molecules

Therapeutic area	N/A
Product description	This product resembles snuff and appeals to people addicted to this or cigarettes. The small and discrete pouches do not contain tobacco but nicotine.
Product name	**Zonnic® Mouth Spray**
Delivery of	Small molecules
Therapeutic area	N/A
Product description	The mouth spray enables fast delivery and absorption of nicotine from the buccal mucosa.
Product name	**Zonnic® Gum**
Delivery of	Small molecules
Therapeutic area	N/A
Product description	The gum comes in two strengths, and has a minty taste. The time acquired for chewing to release all of the nicotine is 10 minutes.

Name	**Novo Nordisk A/S**
Description of organisation	Novo Nordisk is a healthcare company and a world leader in diabetes care. In addition, Novo Nordisk has a leading position within areas such as haemostasis management, growth hormone therapy and hormone replacement therapy.
Development area	**Oral Insulin**
Delivery of	Peptide
Therapeutic area	Hormone related disorders
Development description	The aim is to enable the oral delivery of insulin which is the preferable rout of administration. The challenge is to move an insulin analogue through the gut to exert its therapeutic effect on blood glucose. The project combines Novo Nordisk's unique experience in insulin design in a partnership with Merrion Pharmaceuticals which has experience in transporting proteins through the gastrointestinal tract. Novo Nordisk only proceeds with analogues that do not bind to the IGF-1 receptors that have been linked to the development of cancer. At the end of 2009 a phase 1 clinical trial for an oral insulin analogue was initiated.
Development area	**Oral GLP-1**
Delivery of	Peptide
Therapeutic area	Hormone related disorders
Development description	GLP-1 is a peptide hormone that promotes the syntheses and release of insulin. The aim of the project is to enable oral delivery of GLP-1. The formulation was designed in partnership with Emisphere Technologies and in January 2010 a phase 1 clinical trial of an oral formulation of GLP-1 was initiated.
Development area	**Novo Nordisk Devices**
Delivery of	Peptide
Therapeutic area	Hormone related disorders
Development description	The aim is to develop user-friendly parenteral delivery systems. In 1985, the launch of the NovoPen® insulin pen device pioneered this area. An immediate success, NovoPen® set a new standard in protein delivery. It ensured efficacy, safety and reliability while retaining a subtle and discreet appearance. Since then, Novo Nordisk has developed more than 20 injection systems. They include

	durable, pre-filled and cartridges. Hence, the company has built up profound in-house experience in providing safe products and a solid understanding of user needs.

Name	Pharmacosmos
Description of organisation	Pharmacosmos is a privately-owned pharmaceutical company and operates internationally within three focus areas: 1) Medicine for human iron therapy, 2) Medicine for animal iron therapy, 3 Clinical and technical grade dextrans
Technology name	**CosmoFer®**
Delivery of	Small molecules
Therapeutic area	Nutritional and metabolic disorders
Technology description	CosmoFer® solution for injection contains iron in a stable aqueous iron(III)-hydroxide dextran complex, which is analogous to the physiological form of iron, ferritin. The formulation is characterized by a strong colloidal complex of a ferric core shielded by tightly bound dextran chains. This gives a strong iron-carbohydrate complex, with a gradual release of iron from the iron core, resulting in a superior toxicological profile. Due to the tightly bound iron complex, CosmoFer® offers the opportunity of administering the iron dose either as a conventional series of small IV doses or as a total dose infusion (TDI). CosmoFer® can also be administered as undiluted intramuscular injections. CosmoFer® administered as TDI, improves compliance and reduces the number of injections and hospital visits, resulting in substantial cost savings.

6.6 Universities

Name	Lund University
Faculty name	**Faculty of Engineering, Department of Food Technology**
Research description	The Pharmaceutical Development Group is applying colloid chemistry to drug formulations. Projects include controlled release formulations both of low soluble compounds and of proteins, and oral and nasal delivery of proteins where nanoparticles and mucoadhesive polymers are used. *Contact person: Professor Marie Wahlgren.*
Faculty name	**Faculty of Engineering, Department of Chemical Engineering**
Research description	There are currently ongoing projects in at least three groups. The first group focuses on controlled release formulations including polymer matrix tablets, osmotic pumping release from coated pellets, and release mechanisms for biodegradable microspheres. The second group studies diffusion in gels including diffusion of insulin in swelling gels, hindered diffusion of protein and applications of temperature sensitive gels. The third group deals with spray dried pharmaceuticals for inhalation. Projects include spray dried carbohydrates intended as carriers, studies on the effect of PEG on crystallinity, and of degradation and physical properties of spray dried insulin intended for inhalation. *Contact person: Professor Anders Axelson.*

Faculty name	The Faculty of Science, Department of Chemistry
Research description	At the Department of Chemistry there are several projects related to drug delivery. One branch of these projects deals with biomembranes as a barrier. One group studies diffusive transport in responding membranes where small changes in the external environment can trigger structural changes in the membrane changing the diffusion rate. Another group studies a specific responding membrane, stratum corneum (the upper part of the skin). The combined knowledge can be exploited in e.g. topical delivery systems. Contact person: *Assistant Professor Emma Sparr.* A second branch consists of projects that deal with delivery of nucleic acids, mainly DNA. One approach is to study the application of cyclodextrin in an attempt to achieve a reversible DNA complex. A reversible DNA complex will improve the stability of DNA in vivo and enable the control of transfection efficiency i.e. the introduction of DNA in cells. Another approach is to study the phase behavior of a DNA complex with a cation when mixed with various lipids. The project aims to give a better basis for designing lipoplex formulations for transfection. Finally DNA gel particles and DNA gels are being investigated in particular with regards to the release properties e.g. triggered release. Triggered release of DNA has the prospects of enabling targeted release combined with improved stability in vivo. *Contact person: Professor Björn Lindman.* At the Department of Chemistry there are other projects related to drug delivery among which two will be mentioned here. One project investigates the effect of added drug on a model drug delivery system with the aim of being able to predict what the effect will be in more applied systems. Contact person: Postdoc Joakim Balogh. A second project deals with the self assembly of peptides which is important in designing nanomaterials for e.g. drug delivery. *Contact person: Professor Ulf Olsson.*
Faculty name	**The Faculty of Medicin, Department of Experimental Medical Science**
Research description	An API incorporated in magnetic nanoparticles have successfully been targeted toward metallic implants e.g. stents and artificial knees. The technology can be used to dissolve the thrombus with reduced risk of hemorrhage due to accumulation of the API at the stent. Various API's can possibly be delivered this way to prevent the risk of a secondary thrombus to develop within the stent or to treat an inflammation associated with any implant. *Contact person: Associate Professor Maria Kempe.*

Name	Malmo University
Faculty name	**Biofilms – Research Center for Biointerfaces.**
Research description	In the Biosurface group the interfacial behavior of biologically active

	macromolecules, mainly proteins, are investigated. Effects related to the type and structure of absorbed biomolecules will be correlated to adhesion and adaption data. *Contact person: Director and Associate Professor Johan Engblom.* A second project deals with how a water gradient can be used to regulate drug transport across skin. At normal conditions there is a substantial water gradient over the skin, which leads to a variation in the degree of hydration in the different layers. Changes in this gradient may affect the structure and function of the skin, and hence its transport properties. It has been shown possible to regulate the transport of drugs with different lipophilic characteristics across the skin barrier, and that the rate of transport can be increased substantially at a low water gradient corresponding to a high degree of skin hydration. *Contact person: Director and Associate Professor Johan Engblom* The Prosthetic Density group deals with implant surfaces and interactions with biointerfaces. The aim is to investigate the importance of nano-sized structures and bioactive surfaces for bone and soft tissue integration of implants. A project regarding release of insulin has been initiated and slow release mechanisms of different compounds have been touched on. *Contact person: Professor Ann Wennerberg.*

Name	**Technical University Denmark**
Department name	**DTU Nanotech – Department of Micro- and Nanotechnology**
Research description	DTU Nanotech has major competences in carrier technology. Projects include the understanding of the toxicity of a conventional transfection system using polyethylenimine (PEI) and the development of new biodegradable polymers for transfection. A new patented gene transfection system has been developed that has shown 1000 fold lower toxicity and comparable efficiency to the PEI system. *Contact person: Senior Researcher Thomas Lars Andersen.* Lipid carrier technology has enabled the development of a patented drug delivery system that is activated by enzymes. This drug delivery system enables targeted delivery of various API's in cancer therapy. The lipid carrier technology has also been applied to cancer diagnostics enabling a new image based method. *Contact person: Senior Researcher Thomas Lars Andersen.* A project using nano- and microcarriers aims to develop oral delivery systems of peptides is in progress. Contact person: Senior Researcher Thomas Lars Andersen. Another approach to oral delivery is the use of nanoboxes. The aim is to develop boxes that when delivered orally can adhere to the mucus membrane in the intestine and release the API. If the API is released in a restricted area a high concentration gradient will develop which favors the uptake of the API and increases bioavailability. Furthermore the boxes improve the stability of the API

	through the gastrointestinal tract. The project involves 40-50 man years in collaboration with the DTU Electro, DTU Mathematics, and the Faculty of Pharmaceutical Sciences, University of Copenhagen. *Contact person: Professor Anja Boisen.* The last project deals with nanoscale effects of carrier technology and aims at understanding how morphology and surface chemistry changes formulation properties of APIs and how this knowledge can be implemented in optimization of formulation performance. *Contact person: Senior Researcher Thomas Lars Andersen.*

Name	**University of Copenhagen**
Faculty name	**Faculty of Pharmaceutical Sciences, Department of Pharmaceutics and Analytical Chemistry**
Research description	There are currently four research groups are involved in drug delivery. The first group deals with the pharmaceutical formulation of poorly soluble drug. The aim is to develop tools which enable a rational development of oral formulations. Alternative formulations are being developed including controlled release of the API from a chewing gum for buccal absorption. Liposomes and self-microemulsifying drug delivery systems are included in the approaches. *Contact person: Associate Professor Anette Müllertz.* The second group focuses on Pharmaceutical and Physical Chemistry. In an attempt to manipulate solubility prodrugs are designed as well as the formation of salts. The present focus is on designing depot formulations for intra-articular injection i.e. in the joints. This can have future prospects in combating diseases e.g. rheumatoid arthritis. *Contact Person: Professor Henrik Jensen.* The third group deals with drug transporters in ADME i.e. the absorption of the API, distribution throughout the body, metabolism (degradation) of the API and finally the elimination from the body. The aim is to design and characterize peptidomimetica and prodrugs as substrates for the small intestine membrane transporters. Furthermore the penetration of the blood brain barrier by various prodrugs is investigated. *Contact person: Associate Professor Birger Brodin.* The last group deals with pharmaceutical formulation and delivery of biomacromolecular pharmaceuticals. The research is focused on oral, cutaneous pulmonal and injectable formulations. The formulations under study are polymer- and lipid-based formulations, and they are examined with regard to controlled release properties and enhanced stability of the API.

	Contact person: Associate Professor Hanne Mørck Nielsen.
Center name	**The Center for Pharmaceutical Nanotechnology and Nanotoxicology at the Nano-Science Center**
Research description	The current focus is on polymeric nanoparticles and liposome engineering. Nanoparticles are engineered that can differentiate between quiescent and activated phagocytes and thereby enable targeting of specific stages of a pathological immune response. Targeting of pathological molecules such as the main peptide responsible for Alzheimer's disease, beta amyloid, is made possible through this technology. *Contact person: Director and Professor Moein Moghimi.*
Foundation name	**Lundbeck Foundation Center for Biomembranes in Nanomedicine**
Research description	Novel nanoscale technologies are used to investigate critical protein-membrane and membrane-membrane interactions. The insights gained will form the basis for the subsequent development of prototypical nano-biosensors and design of membrane nanocontainers for drug delivery. *Contact person: Co-director and Associated Professor Dimitrios Stamou.*
Faculty name	**Faculty of Life Sciences, Department of Plant Biology and Biotechnology**
Research description	There is a considerable knowledge in mechanisms of self assembly of large complexes of proteins and polysaccharoses at the department. Polysaccharoses can be used to develop surfaces which can be exploited in medico technology equipment and for drug delivery. We aim at utilizing our position of strength in the field of polysaccharide by targeted contributing in the practical exploitation of nano biotechnology. *Contact person: Head of Institute Ph.D. Anna Haldrup.*

Appendix B: Technology type definitions

- A **stent** is a slender tube inserted inside a tubular body part (as a blood vessel) to provide support during and after surgical anastomosis.
- A **patch** is a piece of soft material that covers and protects an injured part of the body.
- An **inhaler** is a medical device used for delivering medication into the body via the lungs. It is mainly used in the treatment of asthma and Chronic Obstructive Pulmonary Disease (COPD).
- An **injector** is any of various devices that are used to inject something.
- **Depots and implants** are defined as semisolid or solid reservoirs of the API. The release of the API is controlled.
- **Formulation development** is defined as the ability of a company to aid in specific stages of the formulation development. Manufacturing of certain formulation types are included if relevant regarding drug delivery.
- A **liposome** is defined as a lipid based particle of varying size into where the API can be incorporated. Liposomes of nano-size are included in the definition of nanoparticles.
- Modified-release dosage forms assure that an concentration of drug is maintained over an appropriate time interval.
- **Solid dispersion** is defined as the dispersion of the API in a solid solution or in a nano-crystaline state.
- **Gene based targeting** is defined by the incorporation of a gene in a targeted cell. This leads to the synthesis of enzymes with the ability to metabolize a prodrug directly at the target site.
- **Coating and encapsulation** are defined as the encapsulation of the API in a particle greater than nano size. Coating also refers to the covering of the surface of a tablet.
- **Compound engineering** is defined as changes in the structure of the API. This includes conjugation of functional groups, shortening of functional groups, cyclization of the API, etc. The definition includes compounds where the type of compound engineering is not described in details in may thus include linkers.
- A **linker** is defined as a conjugation of a functional group or molecule to the API. The linker does not exhibit any pharmacological response by itself, but increases the pharmacological response of the API.
- **Nanoparticles** are defined as an encapsulation of the API in a particle of nano size or the formation of a complex of nano size. This definition includes nanoboxes, crystalline particles, and constituents for the formation of nanoparticles.