Technology Insight Report

Miniature Drug Delivery System

Patent iNSIGHT Pro
Transform Patents to Intelligence

Miniature or smart drug delivery system is used to deliver drugs to a patient using the biological information. This info is detected with the help of various sensors. MEMS & NEMS technology is used for delivery.

Bio-MEMS typically focuses on mechanical parts and microfabrication technologies made suitable for biological applications. A broad definition for bio-MEMS can be used to refer to the science and technology of operating at the microscale for biological and biomedical applications, which may or may not include any electronic or mechanical functions.

This report takes a look into the patenting activity around miniature/smart drug delivery system, uncovering the key companies, inventors, and different sub categories.

Introduction to Miniature drug delivery system

Nanoelectromechanical systems (NEMS) are devices integrating electrical and mechanical functionality on the nanoscale. NEMS form the logical next miniaturization step from so-called electromechanical system, or MEMS devices. NEMS typically integrate transistor-like nanoelectronics with mechanical actuators, pumps, or motors, and may thereby form physical, biological, and chemical sensors. The name derives from typical device dimensions in the nanometer range, leading to low mass, high mechanical resonance frequencies, potentially large quantum mechanical effects such as zero point motion, and a high surface-to-volume ratio useful for surface-based sensing mechanisms.

Microelectromechanical systems (MEMS) also referred to as micro-electro-mechanical, MicroElectroMechanical or microelectronic and microelectromechanical systems) is the technology of very small devices; it merges at the nano-scale into nanoelectromechanical systems (NEMS) and nanotechnology. MEMS are also referred to as micromachines, or micro systems technology – MST.

MEMS & NEMS based micropumps and microneedles are extensively used. These help to administer accurate doses effectively. Sensors and different communication techniques are used to felicitate the precise diagnosis and treatment.

Overview

With the help of Patent iNSIGHT Pro, we will analyze the patent data around miniature drug delivery to find answers to the following:

- What does the IP publication trend for miniature drug delivery look like and how have the filings evolved?
- Who are the top assignees or key players in miniature drug delivery and what are their technology wise trends?
- How is research in miniature drug delivery spread across different countries?
- What are the different types of sensors used by various companies?
- How different methods of drug delivery used for various applications?
- How is the company portfolio spread across different applications?

Patent Categorization

To get deeper insights the patent set has been classified as follows:

Methods-Drug Delivery

- External
- Internal
- Programmable
- Timed

Sensors

- Amperometric
- Bio-Sensors
- Calorimetric
- Electro-Optic
- Flow
- Glucose
- Impedance
- Photo-Reflective
- Pressure
- Temperature

Micropump

- Osmotic
- Piezoelectric
- Valve

Microneedle

- Hollow
- Porous
- Solid
- Stacked Configuration

Communication System

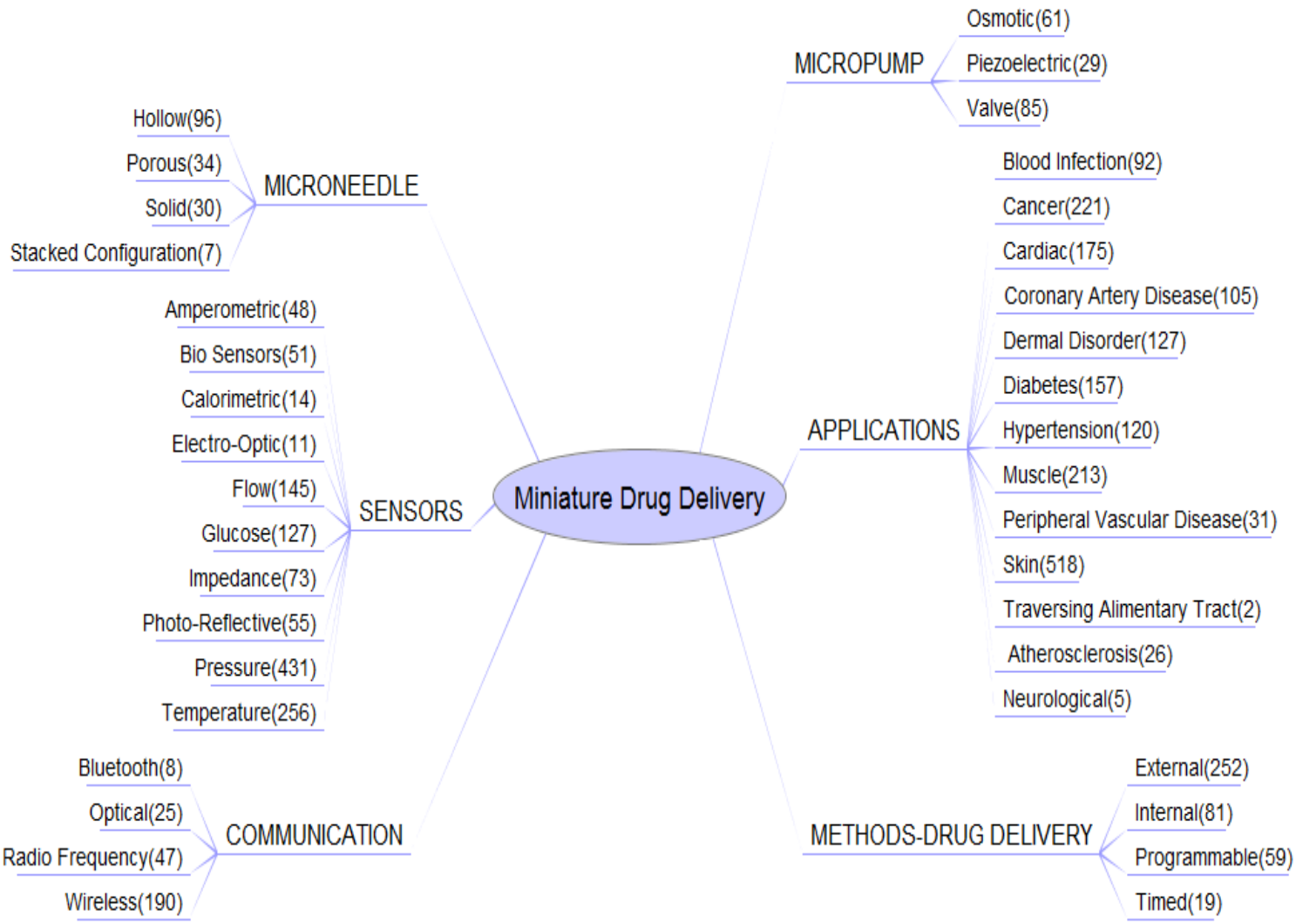
- Bluetooth
- Optical
- Radio Frequency (RF)
- Wireless

Applications

- Atherosclerosis
- Blood Infection
- Cancer
- Cardiac
- Coronary Artery Disease
- Dermal Disorder
- Diabetes
- Hypertension
- Muscle
- Neurological
- Peripheral Vascular Disease
- Skin
- Traversing Alimentary Tract

The illustration below shows the different categories prepared and the number of records in each. The categorization involved defining a search strategy for each topic and then conducting the search using the Advanced Searching capability in Patent iNSIGHT Pro. Details of search strings used for each category are given in Appendix A.

CATEGORIZATION TREE



Search Strategy

Using the commercial patent database PatSeer as our data source we used the following search query to create our patent set.

TAC – Title Abstract Claims
C-Claims
IC- International Classification
PBY- Publication Year

TAC:(Microelectromechanical* or Micropump* or nanopump* or Microneedle* or nanoneedle* or sensor* or nanoject* or Microosmotic* or "MEMS" or "BioMEMS" or "micro-electro-mechanical" or microelectronic* or ("transdermal micro needle"%3 OR "transdermal microneedle*"%3) or ("(micro or nano) (system* or technology or pump* or electromechanical* or needle* or medic* or osmotic* or sensor*)"%3) or nanoelectromechanical or "NEMS" or "BioNEMS")

AND

C:(("(drug* or pharma* or medic*) (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*)"%3))

AND

IC:(A61M37/00 or A61K9/00 or A61K9/16 or A61P35/00 or A61M5/142 or A61K9/14 or A61M31/00 or A61K47/34 or A61M5/00 or A61B5/00 or A61K47/36 or A61K9/22 or A61K9/52 or A61K9/51)

AND

(PBY: [1990 TO 2013])

The queries were combined using the 'OR' operator to search in title, abstract, claims and a patent set of 2545 records with one publication per family was generated.

The publications included in the report are updated as of 14th March, 2013.

Class Descriptions of Classes used in Search Strategy

A61K9/00: Medicinal preparations characterized by special physical form

A61M37/00: Other apparatus for introducing media into the body (for reproduction or fertilisation

A61K9/16: Agglomerates; Granulates; Microbeadlets

A61P35/00: Antineoplastic agents

A61M5/142: Pressure infusion, e.g. using pumps

A61K9/14: Particulate form, e.g. powders (microcapsules A61K 9/50)

A61M31/00: Devices for introducing or retaining media, e.g. remedies, in cavities of the body

A61K47/34: Macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds

A61M5/00: Devices for bringing media into the body in a subcutaneous, intra-vascular or intramuscular way

A61B5/00: Measuring for diagnostic purposes (radiation diagnosis A61B 6/00; diagnosis by ultrasonic, sonic or infrasonic waves A61B 8/00); Identification of persons

A61K47/36: Polysaccharides; Derivatives thereof

A61K9/22: Sustained or differential release type

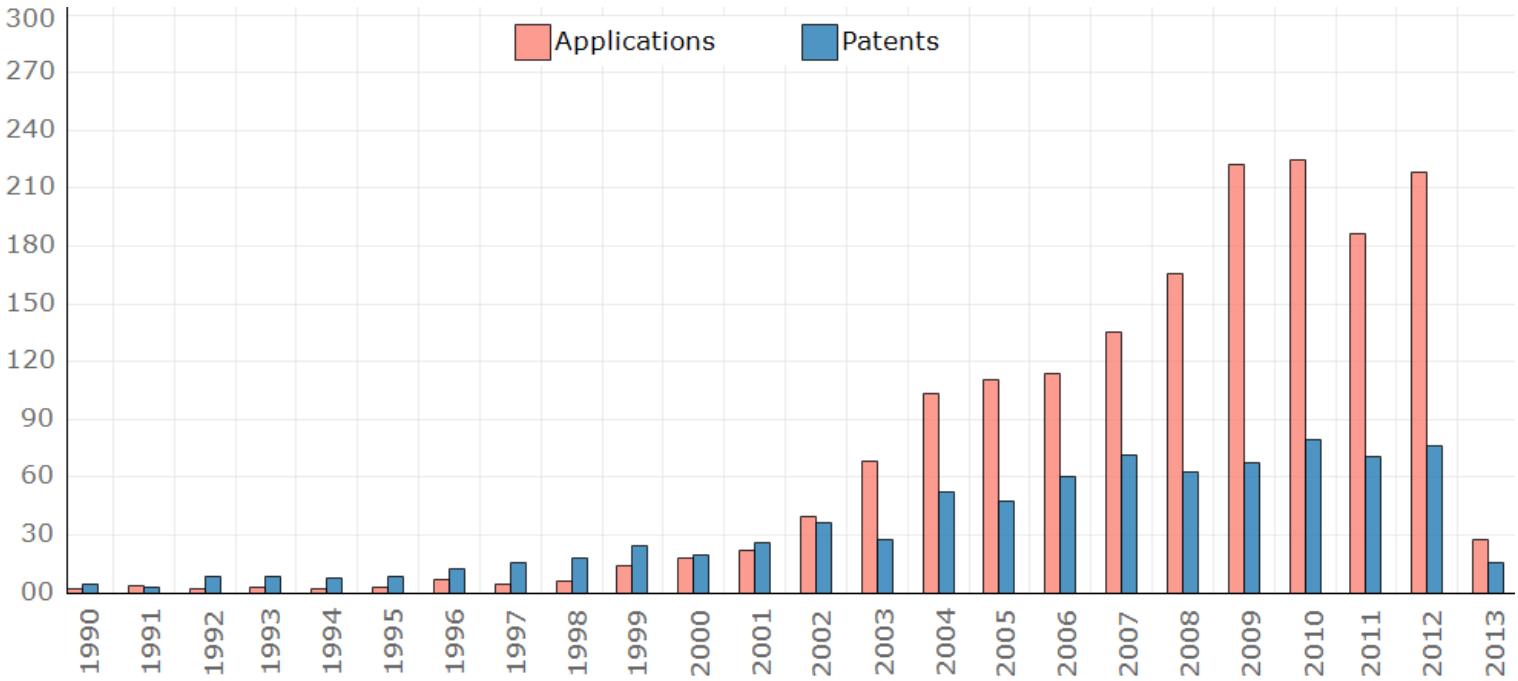
A61K 9/50: Microcapsules

Publication Trend

What has been the IP publication trend for miniature drug delivery system?

The data shows an overall peak of patent activity in 2010.We can see that there are two periods of growth in the last 10 years confirming that since the turn of the century the overall trend is for a rise in the number of applications being published.

The initial phase (1990-2002) in this field lasted up to the year 2002 having around 40 publications during these years. This initial phase was followed by a transition phase (2003-2008) resulting in substantial increase in the patenting activity with around 145 publications. The transition phase, in turn, was followed by a period of very large number of publications during the period 2009-2012 showing a huge increase in patenting activity reaching 225 publications in just three years. Year 2010 comes out to be the year where there were the highest number of publications followed by years 2009, 2012 and 2008.

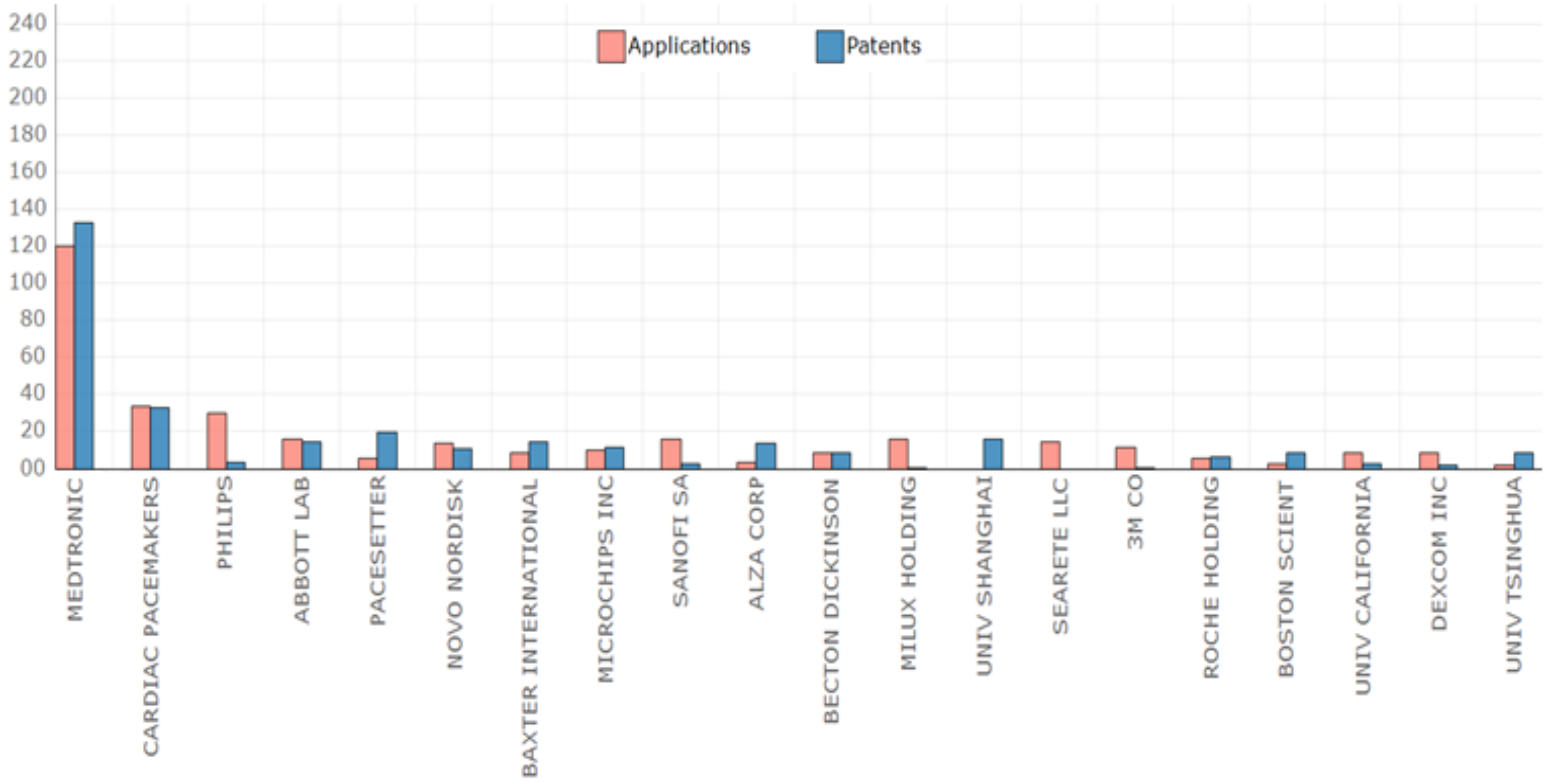


How we did it?

Once the patents were populated in Patent iNSIGHT Pro, the publication trend chart was generated on a single click using the dashboard tool.

Top Assignees

Who have been the top assignees or the key players within this industry?



The top assignees are:

1. MEDTRONIC INC
2. CARDIAC PACEMAKERS INC
3. PHILIPS CORP
4. ABBOTT LAB
5. PACESETTER INC
6. NOVO NORDISK AS
7. BAXTER INTERNATIONAL INC
8. MICROCHIPS INC
9. SANOFI SA
10. ALZA CORP
11. BECTON DICKINSON & CO
12. MILUX HOLDING SA
13. UNIV SHANGHAI
14. SEARETE LLC
15. 3M CO
16. ROCHE HOLDING AG
17. BOSTON SCIENTIFIC CORP
18. UNIV CALIFORNIA
19. DEXCOM INC
20. UNIV TSINGHUA

How we did it?

Once the patents were populated in Patent iNSIGHT Pro, the assignee clean- up tools were used to normalize the names. Different cleanup tools were leveraged:

- To locate assignees for unassigned records
- To clean up records having multiple assignees
- To locate the correct assignee names for US records using the US assignments database

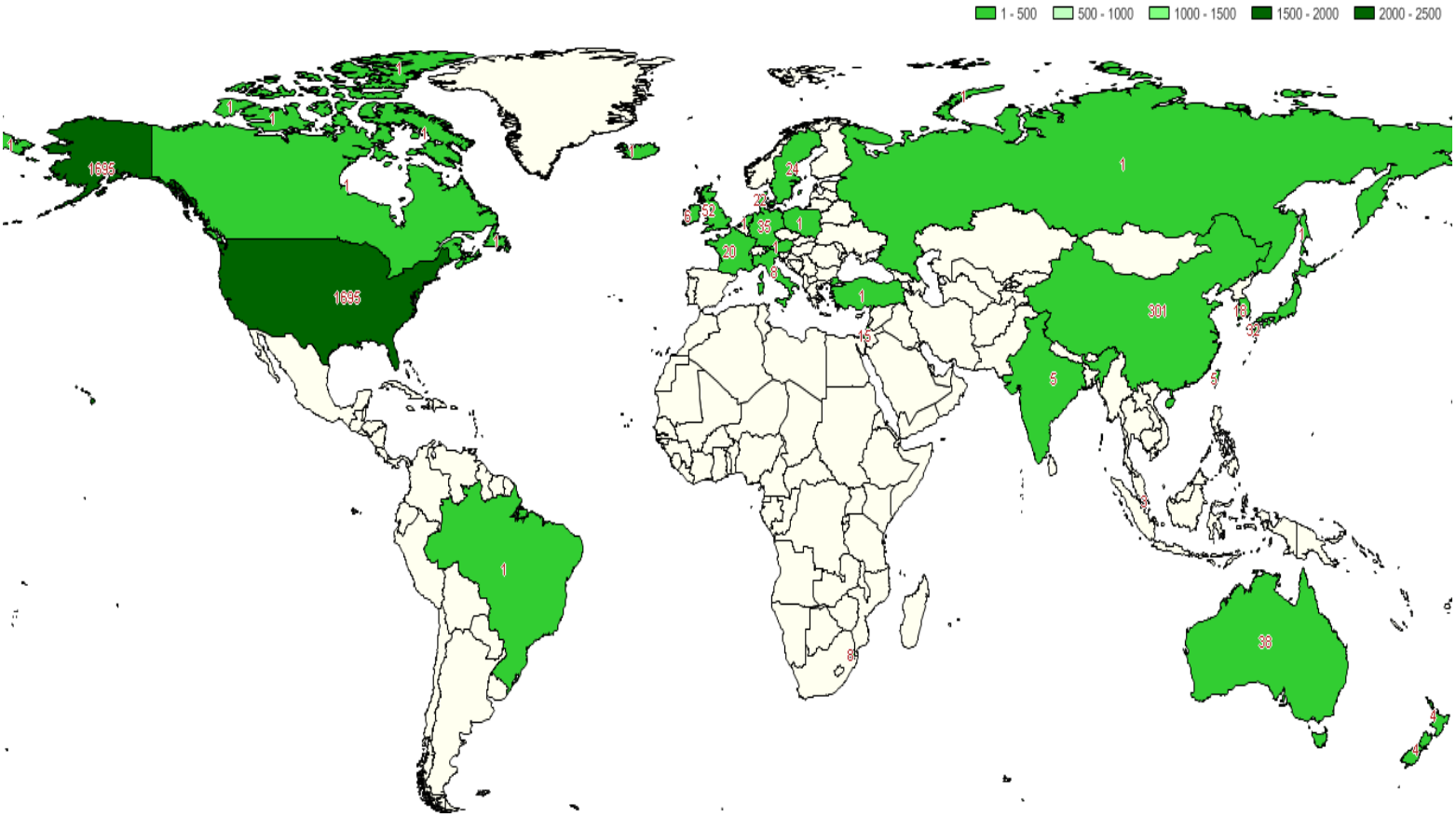
Once the Assignee names were cleaned up, the dashboard tool within Patent iNSIGHT Pro was used to find the top 20 assignees within the given patent set. A visual graph was created based on the results of the top assignees with the number of patents alongside each one.

The complete Assignee table in available in the following Excel file:
http://www.patentinsightpro.com/techreports/0313/List%20of%20Assignees.xls

Top Countries

How is research around miniature drug delivery spread across different countries?

In terms of regional pockets where patent protection is being sought most frequently for these technologies, US leads the count, followed by the CN and EP .The table below ranks top priority countries and helps provide an indication of where innovation in this area is originating:



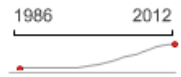
Country Code	Total
US	1695
CN	301
EP	92
GB	52
AU	38

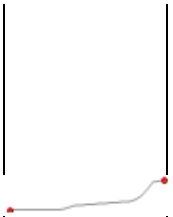
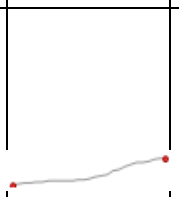
How we did it?

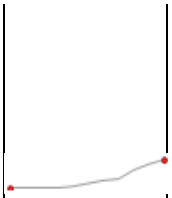
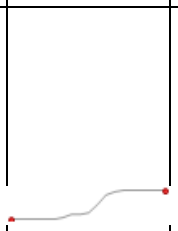
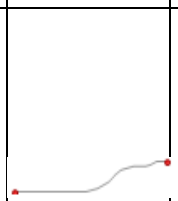
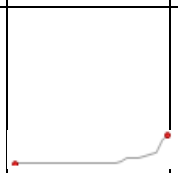
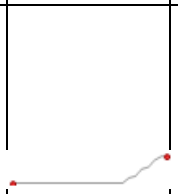
The map was generated using the Priority country coverage map option provided in the dashboard tool within Patent iNSIGHT Pro.

Companies - Key Statistics

Here we summarize key parameters of Top 15 companies such as filing trend, Avg. number of Forward citations per record, Top inventors in each Assignee, Top Co-Assignees and Coverage of underlying patent families

Assignee	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Trend (Cumulative)	Filing Year Range	Key Inventor (Top 5)	Co-Assignees	Coverage (Includes families)						
							US	EP	JP	DE	CN	AU	KR
MEDTRONIC INC	254 (10%)	5.58		1993-2012	MIESEL KEITH A(28) HERUTH KENNETH T(15) GERBER MARTIN T(14) DENISON TIMOTHY J(12) CINBIS CAN(11)	INST NAT SANTE RECH MED(1) MARKOWITZ H TOBY(1)	234	137	47	54	14	32	1
CARDIAC PACEMAKERS INC	67 (2.6%)	1.73		2001-2011	STAHMANN JEFFREY E(11) HATLESTAD JOHN D(9) LEE KENT(8) VON ARX JEFFREY A(8) HARTLEY JESSE W(7)	No Co-Assignee Present	65	38	33	4	2	18	0
PHILIPS CORP	34 (1.3%)	0.26		2005-2011	NISATO GIOVANNI(7) IORDANOV VENTZESLAV P(6) KRIJNSEN HENDRIKA C(6) VAN BRUGGEN MICHEL P B(6) KASSIES ROELF(6)	JANNER ANNA-MARIA(2) RUBINGH JAN-ERIC J M(1)	17	21	18	1	19	0	0

ABBOTT LAB	31 (1.2%)	0.71		1995-2011	HAYTER GARY(4) ELSTROM TUAN A(3) HENNING TIMOTHY P(3) RUSH BENJAMIN(3) SHAIN ERIC B(3)	No Co-Assignee Present	29	15	7	4	6	9	0
PACESETTER INC	26 (1%)	18.6		1987-2011	KOH STEVE(4) EIGLER NEAL L(3) MANN BRIAN(3) TURCOTT ROBERT(3) COLMAN FREDRIC C(2)	No Co-Assignee Present	24	12	5	6	0	2	0
NOVO NORDISK AS	25 (1%)	5.12		1991-2012	NIELSEN OLE CHRISTIAN(8) PREUTHUN JAN HARALD(5) RADMER JIM(5) BENGTSSON HENRIK(4) POULSEN JENS ULRIK(4)	INST OF BIOCYBERNETICS AND BIO(1) TEISEN-SIMONY CLAUDE(1)	17	18	8	8	7	6	3
BAXTER INTERNATIONAL INC	24 (0.9%)	0.21		1988-2010	JACOBSON JAMES D(5) STEWART JANICE(5) BELLO DEBRA K(4) BUI TUAN(4) MEINZER RANDOLPH(4)	No Co-Assignee Present	16	18	15	7	12	20	2
MICROCHIPS INC	22 (0.9%)	3.55		2000-2009	HERMAN STEPHEN J(10) SANTINI JOHN T JR(9) SANTINI JR JOHN T(8) SHEPPARD NORMAN F JR(6) UHLAND SCOTT A(6)	No Co-Assignee Present	22	15	9	9	3	15	2

SANOFI SA	19 (0.7%)	0.05		1990-2012	RICHTER RENE(7) NAGEL THOMAS(4) WITT ROBERT(4) BASSO NILS(3) CLARKE ALASTAIR(2)	No Co-Assignee Present	11	14	10	4	9	10	6
ALZA CORP	18 (0.7%)	2.56		1992-2007	CORMIER MICHEL J N(2) MARIKA KAMBERI(2) PETER DADDONA(2) RAJAN PATEL(1) WONG PATRICK S L(1)	No Co-Assignee Present	16	15	15	2	17	15	11
BECTON DICKINSON & CO	18 (0.7%)	4.67		1999-2010	PETTIS RONALD J(9) DOWN JAMES A(3) HARVEY NOEL G(3) SEARLE GARY(3) MIKSZTA JOHN A(3)	HARVEY NOEL G(1)	16	15	13	7	7	12	1
MILUX HOLDING SA	17 (0.7%)	0.12		2009-2010	FORSELL PETER(16) PETER FORSELL(1)	No Co-Assignee Present	15	15	2	0	2	6	0
UNIV SHANGHAI JIAOTONG	16 (0.6%)	0		2004-2012	HONGZHUA N CHEN(5) CHAO FANG(4) DEHONG YU(4) QIN LU(4) FAN BAI(3)	No Co-Assignee Present	0	0	0	0	16	0	0
SEARETE LLC	15 (0.6%)	0.73		2004-2011	WOOD JR LOWELL L(12) HYDE RODERICK A(11) ISHIKAWA MURIEL Y(9) WOOD VICTORIA Y H(9) SWEENEY	No Co-Assignee Present	15	2	1	0	0	0	1

					ELIZABETH A(9)								
3M CO	13 (0.5%)	2.62		1998-2012	FREDERICKSON FRANKLYN L(4) DUAN DANIEL C(3) CARTER CHAD J(2) JOHNSON PETER R(2) KEISTER JAMIESON C(1)	ERDOGAN-HAUG BELMA(1)	8	9	6	2	4	7	2

How we did it?

From the Assignee 360° report options, we selected Top 15 Assignees and the different pieces of information we wanted to include in the singular display and then ran the report. The generated report was then exported to Excel using the option provided for the same.

Inventor - Key Statistics

Here we summarize key parameters of Top 15 Inventors such as filing trend, average number of forward citations per record, key associated companies and top 5 co-inventors.

Inventor	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Trend (Cumulative)	Filing Year Range	Key Assignees (Top 5)	Co-Inventors
MIESEL KEITH A	29 (1.1%)	10.55		1998-2011	MEDTRONIC INC(28) GEIGER MARK ALLEN(1) KINGHORN CURTIS D.(1) LECKRONE MICHAEL EUGENE(1) MIESEL KEITH ALAN(1)	HERUTH KENNETH T(9) STYLOS LEE(6) DENISON TIMOTHY J(3) ALI IRFAN Z(2) CHRISTOPHERSON MARK A(2)
FORSELL PETER	19 (0.7%)	0.11		2003-2010	MILUX HOLDING SA(16) PROSTHESICA AG(2) INJECTICA AG(1)	No Co-Inventor Present
STAHMANN JEFFREY E	16 (0.6%)	5		2002-2011	CARDIAC PACEMAKERS INC(11) STAHMANN JEFFREY E.(3) LEE KENT(2) NI QUAN(2) STAHMANN JEFFREY E(2)	HARTLEY JESSE W(8) LEE KENT(7) NI QUAN(7) HATLESTAD JOHN D(5) ZHU QINGSHENG(4)
GERBER MARTIN T	15 (0.6%)	1.4		2002-2010	MEDTRONIC INC(14) GERBER MARTIN(1) OLESON KIMBERLY(1)	RONDONI JOHN C(9) OLESON KIMBERLY(1)
HERUTH KENNETH T	15 (0.6%)	3		1999-2011	MEDTRONIC INC(15)	MIESEL KEITH A(9) LENT MARK S(4) BLANCO JUSTIN A(2) GRAVES NINA M(2) LAPORTE STEVE R(2)

WOOD JR LOWELL L	15 (0.6%)	0.27		2004-2011	SEARETE LLC(12) INVENTION SCIENCE FUND I LLC(2) HYDE RODERICK A(1) ISHIKAWA MURIEL Y(1) LEUTHARDT ERIC C(1)	HYDE RODERICK A(12) ISHIKAWA MURIEL Y(11) WOOD VICTORIA Y H(10) LEUTHARDT ERIC C(9) SWEENEY ELIZABETH A(9)
CINBIS CAN	13 (0.5%)	0.54		2006-2012	MEDTRONIC INC(11) CARNEY JAMES K(2) CINBIS CAN(2) SCHUGT MICHAEL A(1) YE QINGSHAN(1)	CARNEY JAMES K(6) KUHN JONATHAN L(6) ANDERSON DAVID A(3) DAVIS TIMOTHY J(3) ECKER ROBERT M(3)
PETTIS RONALD J	13 (0.5%)	1.38		2001-2007	BECTON DICKINSON & CO(9) PETTIS RONALD J.(3) HARVEY NOEL G(2) ALCHAS PAUL G.(2) DOWN JAMES(2)	HARVEY NOEL G(7) DOWN JAMES A(6) ALCHAS PAUL G(3) FERRITER MATTHEW S(2) MARTIN FRANK(2)
DENISON TIMOTHY J	12 (0.5%)	1.67		2007-2011	MEDTRONIC INC(12)	MIESEL KEITH A(3) SANTA WESLEY A(3) MOLNAR GREGORY F(2) ANDERSON JOEL A(1) CONG PENG(1)
HATLESTAD JOHN D	12 (0.5%)	4		2002-2011	CARDIAC PACEMAKERS INC(9) HATLESTAD JOHN D(2) HATLESTAD JOHN(1) STAHMANN JEFFREY E.(1) ZHU QINGSHENG(1)	STAHMANN JEFFREY E(5) ZHU QINGSHENG(4) LEE KENT(3) SIEJKO KRZYSZTOF Z(3) COOK JEFFREY P(2)
HYDE RODERICK A	12 (0.5%)	0.17		2007-2011	SEARETE LLC(11) HYDE RODERICK A(1) ISHIKAWA MURIEL Y(1) LEUTHARDT ERIC C(1) SMITH MICHAEL A(1)	WOOD JR LOWELL L(12) ISHIKAWA MURIEL Y(10) WOOD VICTORIA Y H(10) LEUTHARDT ERIC C(9) KARE JORDIN T(8)

HERMAN STEPHEN J	11 (0.4%)	2.09		2001-2009	MICROCHIPS INC(10) GENZYME CORP(1)	SANTINI JR JOHN T(5) AUSIELLO DENNIS(3) POLITO BENJAMIN F(3) SANTINI JOHN T JR(3) UHLAND SCOTT A(3)
HICKLE RANDALL S	11 (0.4%)	1.27		1999-2012	SCOTT LAB INC(10) ETHICON INC(1)	COBB NICHOLAS E(2) ADAIR W PATRICK(1) ADAIR WILLIAM P(1) BISHOP GREGORY D(1) BRUGGEMAN PAUL J(1)
ISHIKAWA MURIEL Y	11 (0.4%)	0.18		2007-2011	SEARETE LLC(9) HYDE RODERICK A(1) ISHIKAWA MURIEL Y(1) LEUTHARDT ERIC C(1) SMITH MICHAEL A(1)	WOOD JR LOWELL L(11) HYDE RODERICK A(10) WOOD VICTORIA Y H(10) LEUTHARDT ERIC C(9) KARE JORDIN T(7)
THOMPSON DAVID L	11 (0.4%)	30.2		1993-2011	MEDTRONIC INC(11)	GOEDEKE STEVEN D(3) GREENINGER DANIEL R(2) BLAHA ERIC V(1) BONDE ERIC(1) COBIAN RYAN(1)

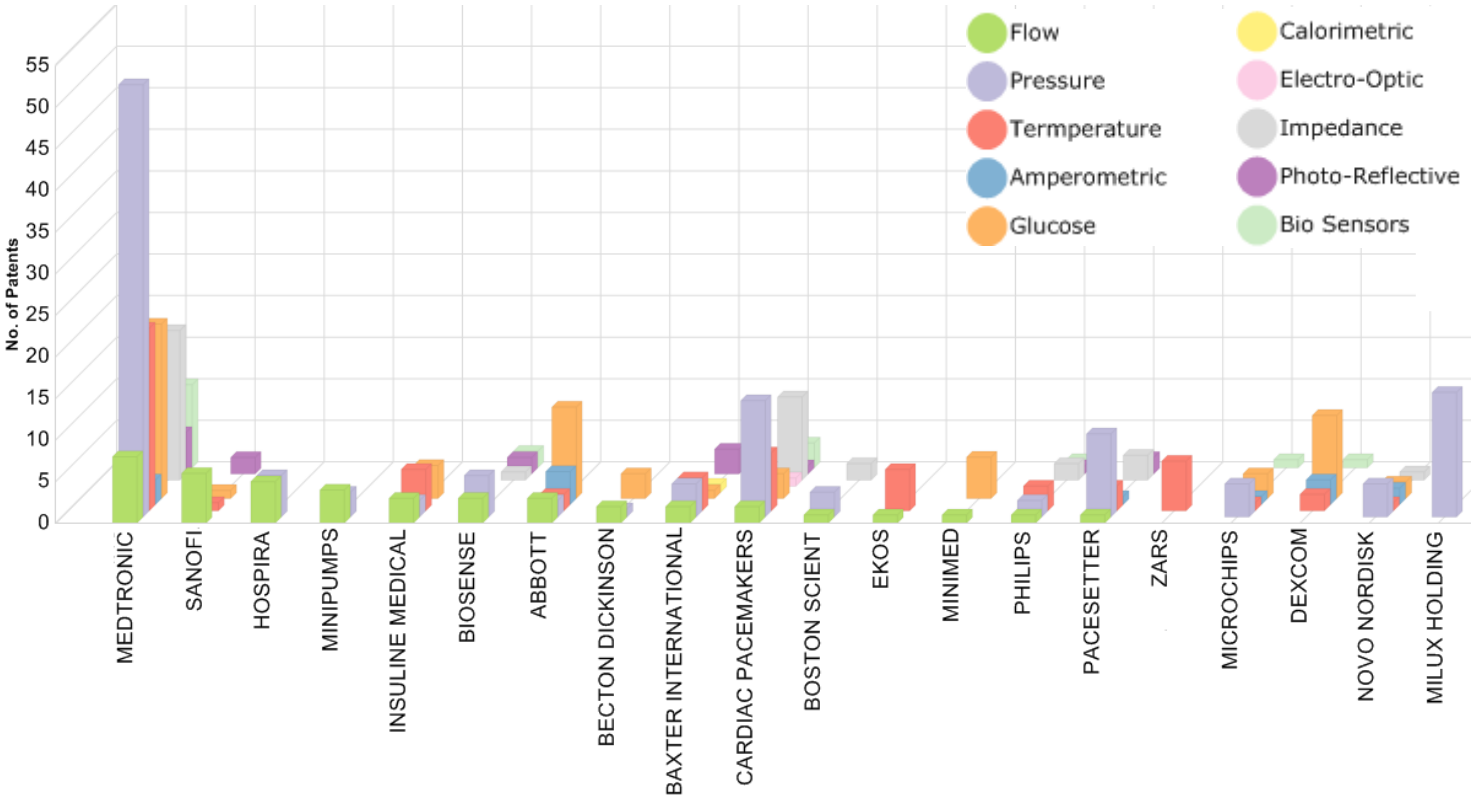
How we did it?

From the Inventor 360° report options, we selected the different pieces of information we wanted to include in the singular display and then ran the report. The generated report was then exported to Excel using the option provided for the same.

Drug Delivery: Company focus across various sensors

What are the different types of sensors used by various companies?

- Chart shows that pressure sensors are the most favored sensors amongst inventors/applicants in sensors technology space.
- Use of pressure sensor by most of the companies.
- Research around pressure sensors is fairly saturated followed by flow and glucose sensors.



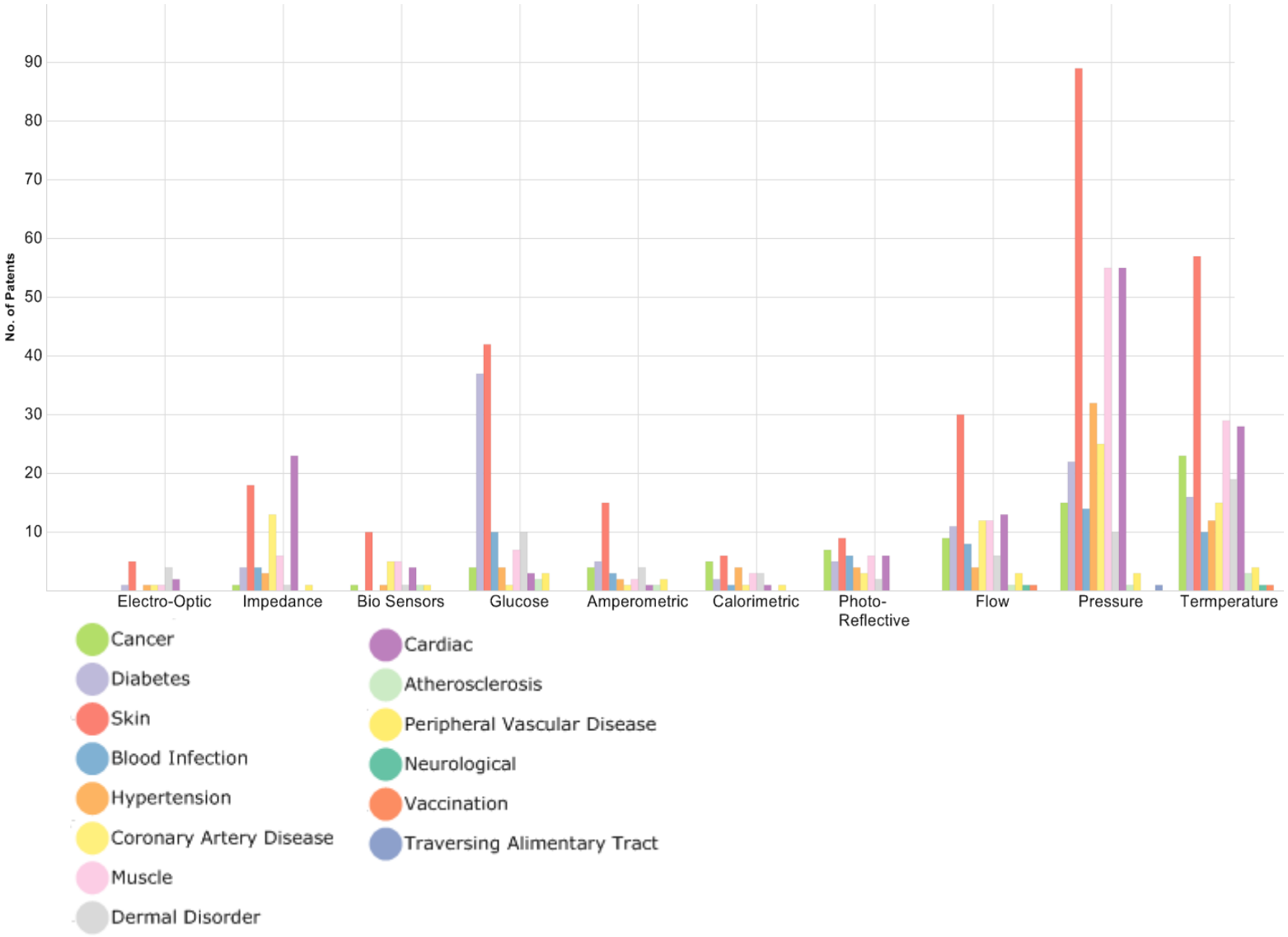
How we did it?

The clusters that were created for analysis were correlated using the co-occurrence analyzer and then the resulting matrix was converted into a 3-D column chart.

Drug Delivery: Applications across various sensors

How are various sensors spread across different applications?

- Pressure, temperature & glucose sensors are the most used sensors.
- There is substantial potential for research amongst other types of sensors as compared to the top 3 types



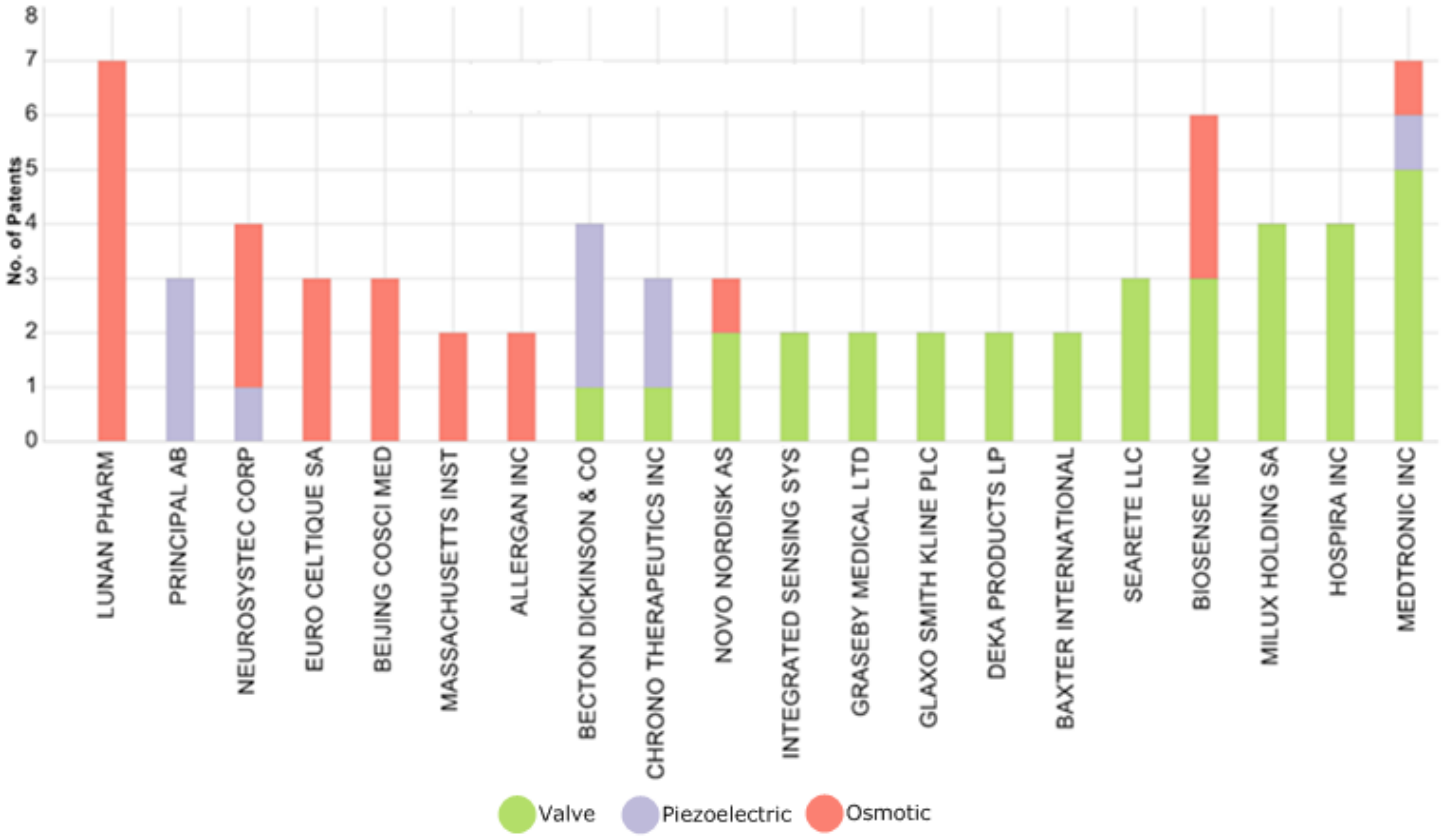
How we did it?

The clusters that were created for analysis were correlated using the co-occurrence analyzer and then the resulting matrix was converted into a clustered column chart.

Drug Delivery: Company focus across micropumps

How is the Assignee portfolio spread across different micropumps?

- Chart below shows that osmotic and valve micropumps are widely used.
- Principal AB has research focused on piezoelectric pumps; whereas Medtronics has research interest in all the types of micropumps.



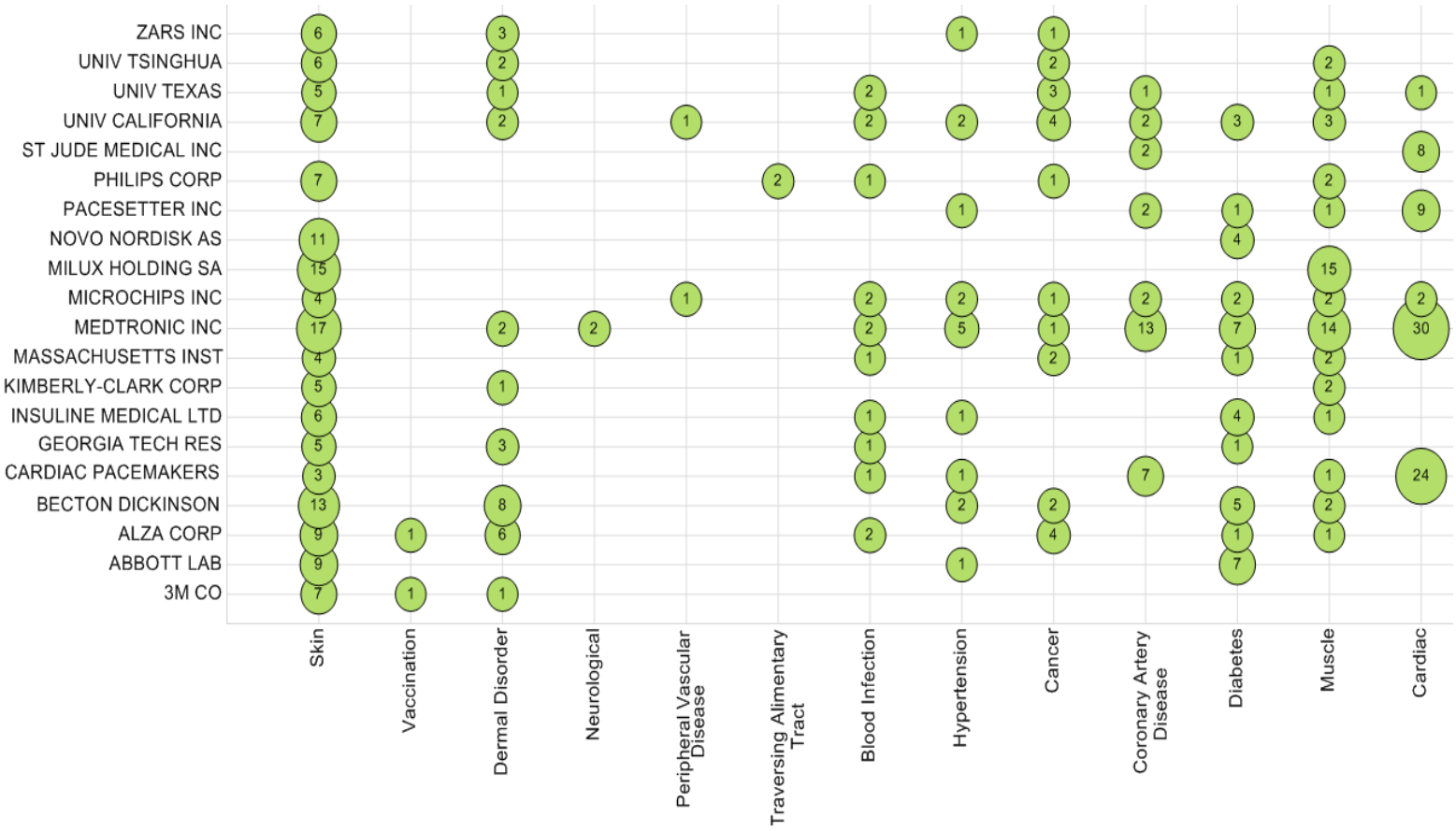
How we did it?

The clusters that were created are correlated using the co-occurrence analyzer and the resulting matrix was converted into a Stacked Column chart.

Drug Delivery: Company across various applications

How is the Assignee portfolio spread across different applications?

- Chart below shows that all the companies except ST Jude Medical and Pacesetter Inc have developed technologies to administer drugs through/to skin.
- It can also be seen that there is minimal research around neurological, Traversing Alimentary Tract and Peripheral Vascular Disease drug administration.



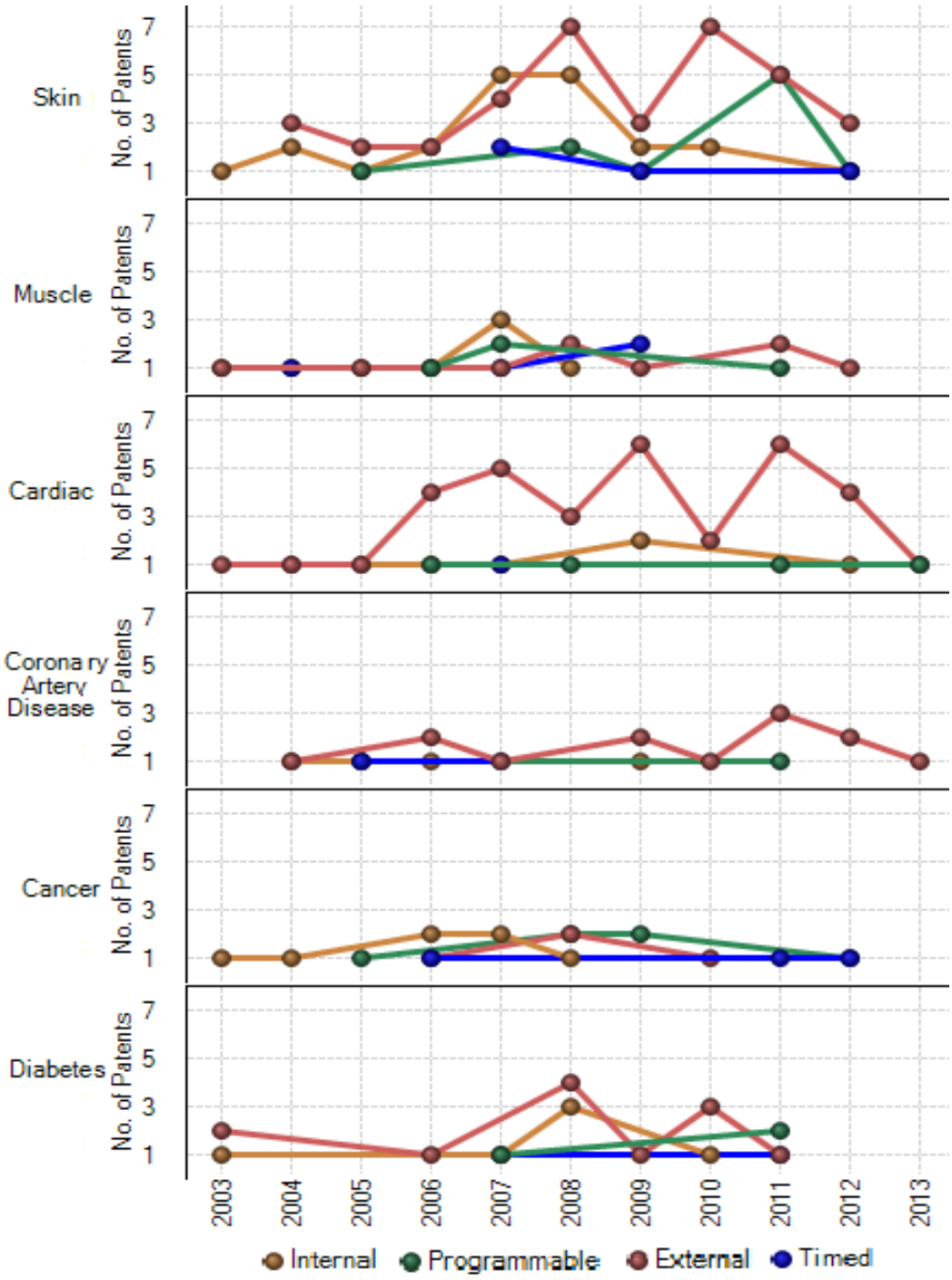
How we did it?

The clusters that were created were correlated using the co-occurrence analyzer and then the resulting matrix was converted into a bubble chart.

Drug Delivery: Applications Vs Methods

Which methods are used across key application areas?

- Chart below shows the different methods used to administer drugs for specific diseases.



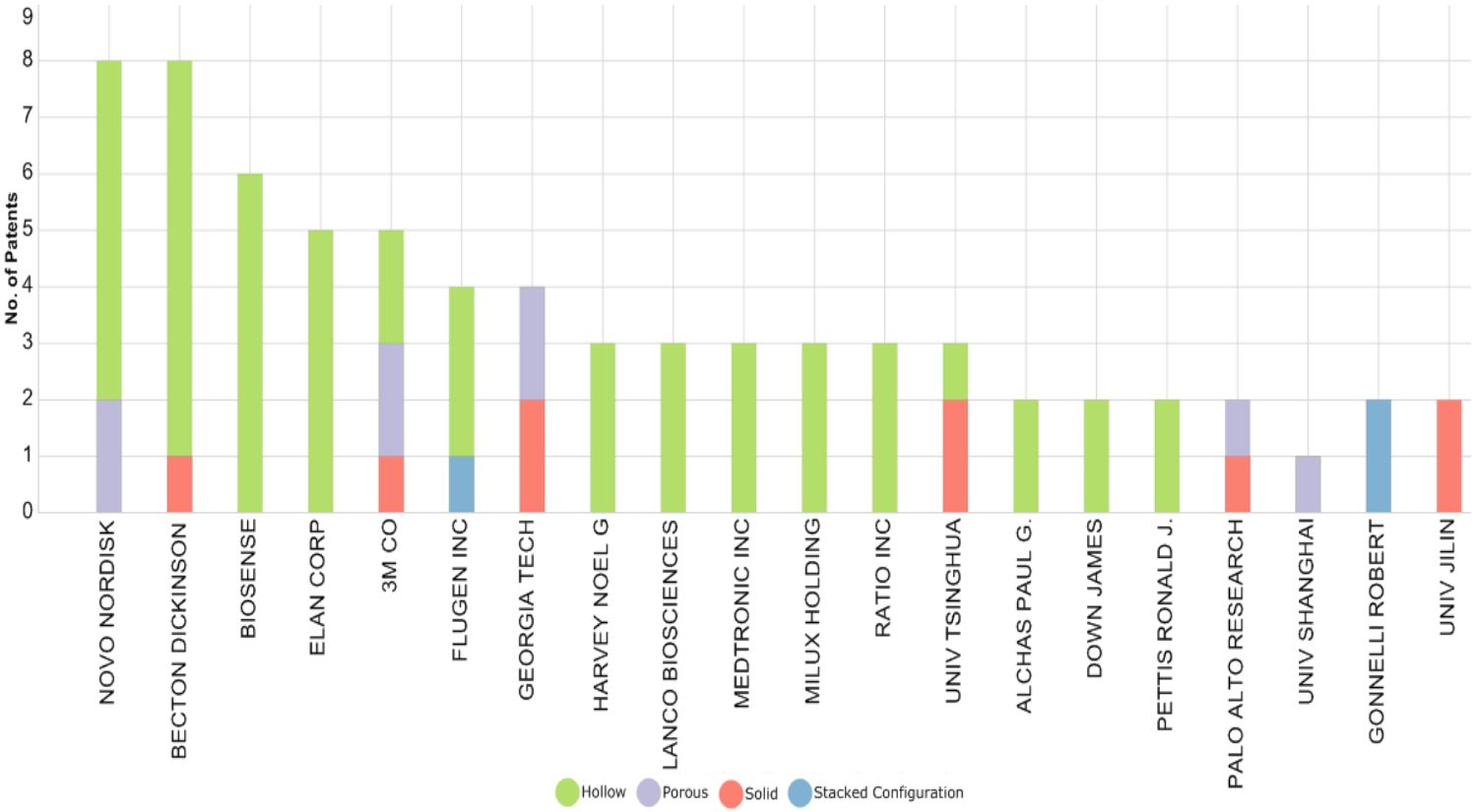
How we did it?

The clusters that were created were correlated using the co-occurrence analyzer and the resulting matrix was converted into a 4-D Matrix containing methods of drug delivery and some filtered applications, publication year and results were restricted to last decade.

Drug Delivery: Company focus across various types of microneedles

How is the company portfolio spread across different microneedles?

- Chart below shows that there is extensive research activity around Hollow microneedles.



How we did it?

The clusters that were created were correlated using the co-occurrence analyzer and then the resulting matrix was represented as stacked column area.

Analysis across different technologies

The matrixes below show the filing trend, top companies and Inventors across respective technologies.

From the Technology 360° report options, we selected the different pieces of information we wanted to include in the singular display and then ran the report. The generated reports were then exported to Excel using the option provided for the same.

Applications

Applications	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Year Range	Top 5 Assignees	Top 5 Inventors
Skin	518 (20.4%)	3.42	1989-2012	MEDTRONIC INC(17) MILUX HOLDING SA(15) BECTON DICKINSON & CO(13) NOVO NORDISK AS(11) ABBOTT LAB(9)	FORSELL PETER(16) PETTIS RONALD J(11) MIESEL KEITH A(7) BITTON GABRIEL(7) NAGAR RON(7)
Cancer	221 (8.7%)	0.69	1988-2012	NOVARTIS AG(5) ALZA CORP(4) EURO CELTIQUE SA(4) UNIV CALIFORNIA(4) UNIV SHANGHAI JIAOTONG(4)	DRIZEN ALAN(4) QIN LU(3) HOLGER PETERSEN(3) CHASIN MARK(3) MARKUS AHLHEIM(3)
Muscle	213 (8.4%)	2.41	1988-2012	MILUX HOLDING SA(15) MEDTRONIC INC(14) BIOSENSE INC(4) PNEUMOFLEX SYSTEMS LLC(4) ALLERGAN INC(3)	FORSELL PETER(15) ADDINGTON ROBERT(4) MILLER STUART(4) STEPHENS ROBERT(4) ZHOU XIAOHONG(3)
Cardiac	175 (6.9%)	5.77	1988-2012	MEDTRONIC INC(30) CARDIAC PACEMAKERS INC(24) PACESETTER INC(9) ST JUDE MEDICAL INC(8) BIOSENSE INC(5)	FISCHELL DAVID R(6) CARLSON GERRARD M(6) STAHMANN JEFFREY E(6) BROCKWAY MARINA(5) HATLESTAD JOHN D(5)
Diabetes	157 (6.2%)	2.59	1988-2012	MEDTRONIC INC(7) ABBOTT LAB(7) BECTON DICKINSON & CO(5) INSULINE MEDICAL LTD(4) NOVO NORDISK AS(4)	BITTON GABRIEL(5) NAGAR RON(5) PESACH BENNY(5) WEISS RAM(3) PALMER CYNTHIA LOUISE(2)
Dermal Disorder	127 (5%)	4.8	1989-2012	BECTON DICKINSON & CO(8) ALZA CORP(6) ELAN CORP PLC(5) PRINCIPAL AB(3)	PETTIS RONALD J(10) HARVEY NOEL G(5) DOWN JAMES A(5) GROSS JOSEPH(5)

				UNIV RUTGERS(3)	KELLY JOHN GERARD(4)
Hypertension	120 (4.7%)	1.29	1987-2012	MEDTRONIC INC(5) ZHANG QINGLONG(3) ALTEA THERAPEUTICS CORP(3) NITROMED INC(3) ACIST MEDICAL SYS INC(3)	EPPSTEIN JONATHAN A(4) GARVEY DAVID S(4) ZHANG QINGLONG(3) SMITH ALAN(3) WILSON ROBERT F(2)
Coronary Artery Disease	105 (4.1%)	3.7	1988-2011	MEDTRONIC INC(13) CARDIAC PACEMAKERS INC(7) BIOSENSE INC(5) BIOTRONIK CRM PATENT AG(3) MATREGEN CORP(2)	FISCHELL DAVID R(3) ROSS JEFFREY(3) MATCOVITCH AVRAHAM(3) CAFFERATA ROBERT(3) YARON URI(3)
Blood Infection	92 (3.6%)	1.1	1989-2010	ALTEA THERAPEUTICS CORP(3) GENENTECH INC(2) UNIV TEXAS(2) SPECTRX INC(2) MEDTRONIC INC(2)	EPPSTEIN JONATHAN A(3) HATCH MICHAEL R(3) BORCHARDT ALLEN J(2) MCALLISTER DEVIN V(2) KANIA ROBERT STEVEN(2)
Peripheral Vascular Disease	31 (1.2%)	2.84	2000-2011	ANGIOTECH INT AG(2) ENDOBIONICS INC(2) NITROMED INC(2) MICHIGAN CRITICAL CARE CONSULT(1) MOR RESEARCH APPLIC LTD(1)	GARVEY DAVID S(3) GOLD MARK S(2) MELKER RICHARD J(2) SACKELLARES JAMES C(2) BARR LYNN MATEEL(2)
Atherosclerosis	26 (1%)	1.5	1999-2011	UNIV SHANGHAI JIAOTONG(3) NITROMED INC(2) UNIV MICHIGAN(1) ANGIOTECH INT AG(1) UNIV MARYLAND(1)	FAN BAI(3) HONGZHUAN CHEN(3) MEI ZHAO(3) QIN LU(3) GARVEY DAVID S(3)
Vaccination	9 (0.4%)	0	2001-2012	OXFORD GLYCOSCIENCES UK LTD(1) ALZA CORP(1) US GOV HEALTH & HUMAN SERV(1) UCB PHARMA SA(1) SANOFI SA(1)	CHAMBERS RICHARD C(1) SCHLOM JEFFREY(1) OKULAN NIHAT(1) STAMPS ALASDAIR CRAIG(1) CIGARINI SANDRINE(1)
Neurological	5 (0.2%)	1.6	2003-2010	MEDTRONIC INC(2) WILLENBRING JAMES E(1) HOBBS JONATHAN P(1) NEUROPACE INC(1) AUDET SARAH A(1)	GOTTESMAN JANELL M(1) HILL GERARD J(1) MANRODT CHRISTOPHER M(1) MARKOWITZ H T(1) RUETER JOHN C(1)
Traversing Alimentary Tract	2 (0.1%)	0	2006	PHILIPS CORP(2)	NAAMAT JUDY RUTH(2) TROVATO KAREN I(2) HERZKA DANIEL(1) OUWERKERK MARTIN(1)

Sensors

Sensors	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Year Range	Top 5 Assignees	Top 5 Inventors
Pressure	431	6.01	1986-2012	MEDTRONIC INC(52) MILUX HOLDING SA(15) CARDIAC PACEMAKERS INC(14) PACESETTER INC(10) BIOSENSE INC(5)	FORSELL PETER(16) MIESEL KEITH A(12) STYLOS LEE(6) GROSS JOSEPH(6) HETTRICK DOUGLAS A(5)
Temperature	256	6.63	1988-2012	MEDTRONIC INC(22) CARDIAC PACEMAKERS INC(7) ZARS INC(6) INSULINE MEDICAL LTD(5) EKOS CORP(5)	MIESEL KEITH A(6) BITTON GABRIEL(5) NAGAR RON(5) PESACH BENNY(5) ZHANG JIE(5)
Flow	145	6.12	1986-2012	MEDTRONIC INC(8) SANOFI SA(6) HOSPIRA INC(5) MINIPUMPS LLC(4) SENSILE PAT AG(3)	RICHTER RENE(6) CAFFEY SEAN(5) NAGEL THOMAS(4) WITT ROBERT(4) JACOBSON JAMES D(4)
Glucose	127	7.31	1988-2012	MEDTRONIC INC(21) ABBOTT LAB(11) DEXCOM INC(10) MINIMED INC(5) INSULINE MEDICAL LTD(4)	LEBEL RONALD J(7) BRAUKER JAMES H(7) STARKWEATHER TIMOTHY J(6) WEISS PHILLIP T(6) KAMATH APURV U(6)
Impedance	73	5.48	1989-2012	MEDTRONIC INC(18) CARDIAC PACEMAKERS INC(10) PACESETTER INC(3) BROCKWAY MARINA(2) HERNDON TERRY O(2)	CHO YONG KYUN(4) BROCKWAY MARINA(4) SALO RODNEY(3) ZHANG YI(3) CARLSON GERRARD M(3)
Photo-Reflective	55	14.33	1988-2011	MEDTRONIC INC(5) BAXTER INTERNATIONAL INC(3) BIOSENSE INC(2) FORHEALTH TECHNOLOGIES INC(2) FLAHERTY J C(2)	DAVIS TIMOTHY J(3) REINKE JAMES D(3) FLAHERTY J C(2) NASIRI ABDOLHOSEIN(2) QUN LI(2)
Bio Sensors	51	8.27	1991-2012	MEDTRONIC INC(10) HERBST EWA(3) CARDIAC PACEMAKERS INC(3) CARDIOMEMS INC(3) BIOSENSE INC(2)	DENISON TIMOTHY J(4) WHITE JASON(3) HERBST EWA(3) HILL GERARD J(3) ZHANGMIN YANG(2)
Amperometric	48	6.52	1995-2011	ABBOTT LAB(4) DEXCOM INC(3) MEDTRONIC INC(3) UNIV CONNECTICUT(2)	HAN IN SUK(3) HUNTER WILLIAM L(3) MAGDA JULES JOHN(3) SHAH RAJIV(3)

				BIOTECH INC M(2)	GONNELLI ROBERT R(3)
Calorimetric	14	0.43	1996-2011	UNIV RUTGERS(2) AVENTIS PHARMA LTD(1) MILLENNIUM PHARMA INC(1) DOW GLOBAL TECHNOLOGIES INC(1) ARX JEFFREY ALLEN VON(1)	KOHN JOACHIM B(2) KWOK JONATHAN(1) LECHUGA-BALLESTEROS DAVID(1) HENGERER ARNE(1) PATTON JOHN S(1)
Electro-Optic	11	5.27	1994-2012	PRINCIPAL AB(3) BIOTRONIK CRM PATENT AG(2) GERRANS LAWRENCE J(1) GUNDAY ERHAN H(1) CARDIAC PACEMAKERS INC(1)	SVEDMAN PAL(3) DOERR THOMAS(2) WEISS INGO(2) WOOD JR LOWELL L(1) GERRANS LAWRENCE J(1)

Communication

Communication	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Year Range	Top 5 Assignees	Top 5 Inventors
Wireless	190	6.25	1989-2012	MEDTRONIC INC(19) CARDIAC PACEMAKERS INC(12) ABBOTT LAB(5) BAXTER INTERNATIONAL INC(4) PHILIPS CORP(4)	VON ARX JEFFREY A(5) CHAVAN ABHI(5) MAILE KEITH R(5) FISCHELL DAVID R(4) HILL GERARD J(4)
Radio Frequency(RF)	47	3.66	1996-2012	MEDTRONIC INC(7) CARDIAC PACEMAKERS INC(6) HITACHI GLOBAL STORAGE TECHNOLOGIES LTD(4) ABBOTT LAB(3) DEXCOM INC(2)	VON ARX JEFFREY A(5) FELISS NORBERT(4) GILLIS DONALD RAY(4) CHAVAN ABHI(3) MAZAR SCOTT T(3)
Optical	25	3.2	1999-2012	MEDTRONIC INC(2) GUILLORY K S(1) SERRUYA MIJAIL D(1) CARDIAC PACEMAKERS INC(1) ARX JEFFREY ALLEN VON(1)	CHAVAN ABHI(2) MAZAR SCOTT T(2) VON ARX JEFFREY A(2) BITTON GABRIEL(2) NAGAR RON(2)
Bluetooth	8	0	2003-2012	ABBOTT LAB(2) DEXCOM INC(2) YERUSHALMY ISRAEL(1) AWARE TECHNOLOGIES INC(1) CHRISTOPHER ELLEDGE(1)	DOBBLES JOHN MICHAEL(2) KAMATH APURV U(2) MENSINGER MICHAEL ROBERT(2) YANG RICHARD C(2) RUPPERT DEBORAH M(1)

Methods- Drug Delivery

Methods -Drug Delivery	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Year Range	Top 5 Assignees	Top 5 Inventors
External	252	4.99	1989-2012	MEDTRONIC INC(79) CARDIAC PACEMAKERS INC(28) MINIMED INC(5) INSULINE MEDICAL LTD(5) PHILIPS CORP(5)	MIESEL KEITH A(13) HERUTH KENNETH T(10) GERBER MARTIN T(9) BARDY GUST H(7) DENISON TIMOTHY J(7)
Internal	81	1.42	1994-2012	MEDTRONIC INC(7) INSULINE MEDICAL LTD(4) BIOSENSE INC(3) GONNELLI ROBERT R(2) PACESETTER INC(2)	GONNELLI ROBERT R(3) BITTON GABRIEL(3) NAGAR RON(3) PESACH BENNY(3) WEISS RAM(3)
Programmable	59	8.81	1987-2012	MEDTRONIC INC(16) MEDICAL RES GROUP(4) MINIMED INC(4) CHRONO THERAPEUTICS INC(3) NILIMEDIX LTD(2)	LEBEL RONALD J(7) STARKWEATHER TIMOTHY J(6) WEISS PHILLIP T(6) SHAHMIRIAN VARAZ(5) VILLEGAS DANIEL H(5)
Timed	19	7.68	1994-2012	CHRONO THERAPEUTICS INC(2) BALL SEMICONDUCTOR INC(2) EV3 INC(1) STAAB ROBERT J(1) INT MEDICAL ASSOCIATES INC(1)	DIPIERRO GUY(2) AHN SAMUEL S(2) AHN SUZANNE I(2) GAFFNEY F ANDREW(2) HAYS STEVEN R(2)

Micropump

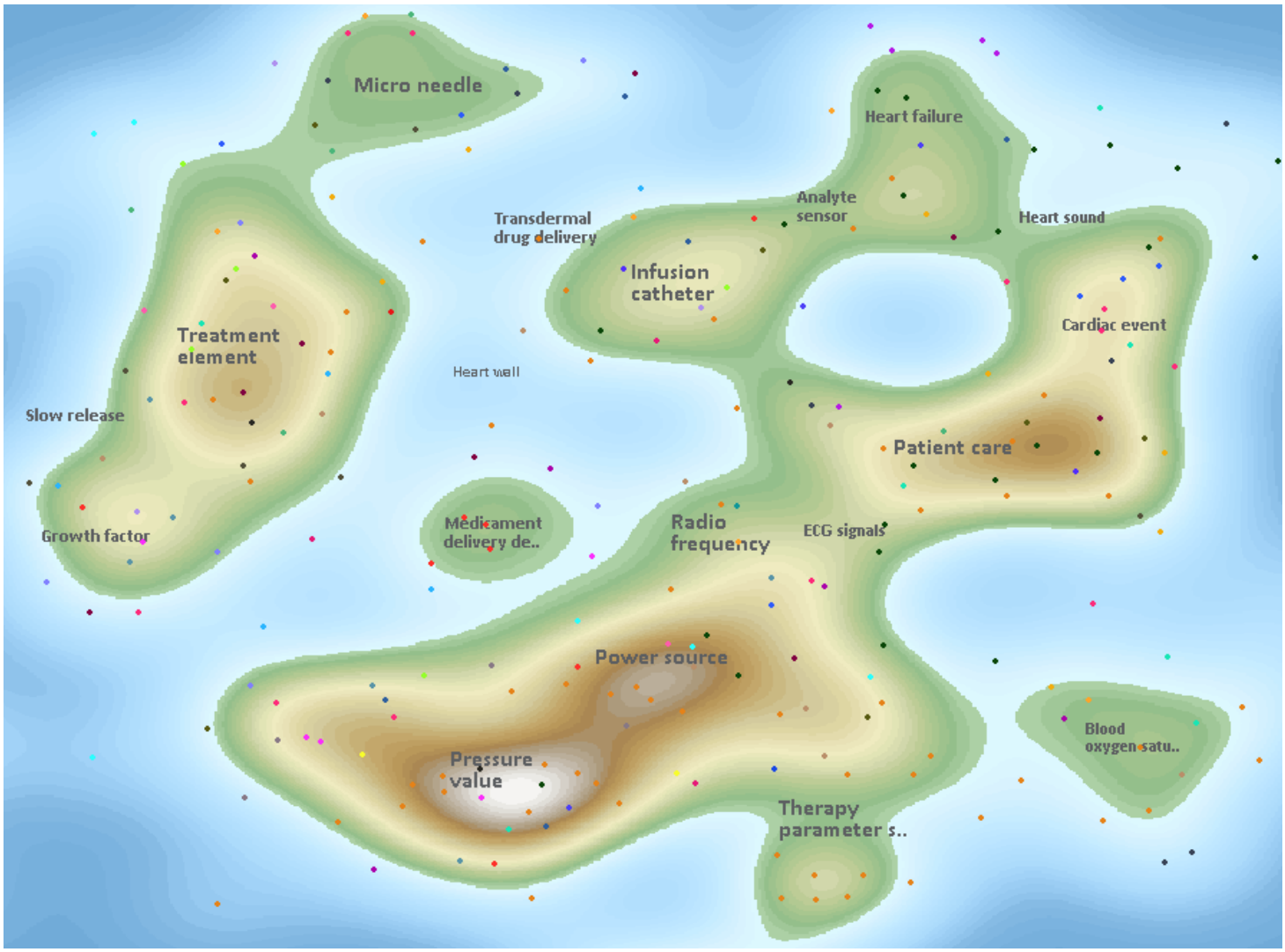
Micropump	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Year Range	Top 5 Assignees	Top 5 Inventors
Valve	85	4.26	1987-2012	MEDTRONIC INC(5) HOSPIRA INC(4) MILUX HOLDING SA(4) BIOSENSE INC(3) SEARETE LLC(3)	FORSELL PETER(6) GARVEY DAVID S(3) ECKHOFF PHILIP A(3) HYDE RODERICK A(3) ISHIKAWA MURIEL Y(3)
Osmotic	61	0.74	1994-2011	LUNAN PHARM GROUP CORP(7) BEIJING COSCI MED TECH CO LTD(3) EURO CELTIQUE SA(3) NEUROSYSTEC CORP(3) BIOSENSE INC(3)	ZHIQUAN ZHAO(7) HAISONG JIANG(3) JINGANG WANG(3) OSHLACK BENJAMIN(3) WRIGHT CURTIS(3)
Piezoelectric	29	5.38	1988-2012	PRINCIPAL AB(3) BECTON DICKINSON & CO(3) BOEHRINGER INGELHEIM GMBH(2) CHRONO THERAPEUTICS INC(2) HARVEY NOEL G(2)	SVEDMAN PAL(3) DOWN JAMES A(3) PETTIS RONALD J(3) DIPIERRO GUY(2) ALCHAS PAUL G(2)

Microneedle

Microneedle	Total No. of Records	Avg. No. of Fwd Cites per Patents	Filing Year Range	Top 5 Assignees	Top 5 Inventors
Hollow	96	6.91	1993-2012	BECTON DICKINSON & CO(8) NOVO NORDISK AS(8) BIOSENSE INC(6) 3M CO(5) ELAN CORP PLC(5)	PETTIS RONALD J(8) RADMER JIM(5) GROSS JOSEPH(5) DOWN JAMES A(5) HARVEY NOEL G(5)
Porous	34	1.5	1999-2012	GEORGIA TECH RES INST(4) 3M CO(3) GONNELLI ROBERT R(2) NOVO NORDISK AS(2) PALO ALTO RESEARCH CENTER INC(2)	PRAUSNITZ MARK R(4) GONNELLI ROBERT R(3) DUAN DANIEL C(3) JOHNSON PETER R(3) BAI XU(2)
Solid	30	4.23	1993-2012	GEORGIA TECH RES INST(2) UNIV TSINGHUA(2) UNIV JILIN(2) BEIJING LINGRUI HIGH TECH CO LTD(1) SHANGHAI TAIYIN BIOLOG TECHNOLOGY CO LTD(1)	RUIFENG YUE(2) YAN WANG(2) JINGYING ZHANG(2) MINJIE LI(2) XIAOAN ZHANG(2)
Stacked Configuration	7	4.71	2001-2011	GONNELLI ROBERT R(2) REDEON INC(1) BIOVALVE TECHNOLOGIES INC(1) JANISYS LTD(1) UNGER EVAN C.(1)	GONNELLI ROBERT R(3) ACKLEY DONALD E(1) NICKEL JANICE H(1) UNGER EVAN C(1) WU YUNQIU(1)

Landscape for different methods used for drug delivery

The contour map below represents different technologies in drug delivery with respect to complete patent portfolio. Clusters for treatment element and growth factor are close to each other as there is high degree of relevance between the records present in those technology areas. Whereas medicament delivery is represented as a different cluster as it has less relevance with the other technologies present in the portfolio.



Note: In the map above, records are placed based on their contextual similarity shared with neighboring records. Closer the clusters, more is the overlap or correlation between them. Each cluster or topic appears as either a shallow water area or land mass. Closely related topics collate to form larger land masses having individual peaks based on those topics that have maximum records. Labels for topics that are shared across various peaks appear between them.

How we did it?

The categories created at the top level on methods for drug delivery were used as the base set for creating technology landscapes. Each category was loaded into VizMAP and then contextually clustered (using Title and Abstract as the text) using the 'Context Mode' option to generate its technology landscape. (The contour based thematic coloring option is automatically enabled in the Context mode in VizMAP.) We refined each of the generated map in two ways. We removed unrelated patents using the "Hide Unrelated records" option. In such maps unrelated records are those that do not share any similarity with any of the generated technology. Clusters appear usually in the blue ocean areas away from the land parcels. Since they don't have any significance for the map, and then can simply be removed using the above mentioned option.

Upcoming Companies: Focus on priority countries, filings and technology areas

The table below shows the research activity for the companies in different countries.

Companies	Priority Countries								
	US	FR	CH	IB	EP	JP	IE	IL	AU
ALTEA THERPEAUTICS CORP	4								
ARDIGAM CORP	7								
ARTENGA ING	2								
CARDIOMEM INC	4								
CRISI MEDICAL SYSTEMS INC	2								
DEBIOTECH SA		2	1	1	2				
DEXCOM INC	11								
EKOS CORP	4					1			
ELAN CORP PLC	2						4		
FLUGEN INC	4								
HOSPIRA INC	8								
INTELLIJECT INC	2								1
MEDINGO LTD	3							1	
MINIPUMPS LLC	5								
NEKTAR THERAPEUTICS	1								
NEUROSYSTECH CORP	4								
OREXO AB	1								
PSIVIDA INC	2								
RATIO INC	3								
SICEL TECHNOLOGIES INC	4								
SPECTRX INC	2								
STEADYMED LTD	1							2	

How we did it?

We researched online for some of the companies focusing on drug delivery technologies of which we grouped companies present in our data set and filtered those within reports dashboard and using the Assignees tab identified respective priority countries.

Note: Please refer Appendix B for patent details for these companies

The below matrix shows year wise filings for the companies

Filing Year / Companies	Total	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	86	1	2	4	3	2	5	1	1	2	6	1	5	2	6	9	9	10	8	7	2
Dexcom Inc	11											1	1				5	4			
Hospira Inc	8									1	2					1	1	2	1		
Aradigm Corp	7			3	1		2			1											
Elan Corp Plc	6	1	1	1	2	1															
Debiotech SA	6		1			1								1		1	1	1			
Minipumps Llc	5																		2	2	1
Ekos Corp	5						3				1									1	
Sicel Technologies Inc	4										2		2								
Neurosystech Corp	4														2	2					
Medingo Ltd	4														1		1	1	1		
Cardiomem Inc	4														2	2					
Altea Theapeutics Corp	4							1	1				2								
Steadymed Ltd	3													1		1		1			
Ratio Inc	3																		2	1	
Intellijject Inc	3														1	1					1
Spectrx Inc	2							1					1								
Psivida Inc	2																1		1		
Crisi Medical Systems Inc	2																		1	1	
Artenga Inc	2															1		1			
Orexo AB	1																			1	
Nektar Therapeutics	1										1										
Flugen Inc	1																			1	

How we did it?

Once upcoming companies were identified, we filtered records for those companies and moved those to respective user defined categories. In co-occurrence analyzer, within Matrix Parameters, filing year was selected and clusters were correlated with time and the resulting matrix was exported to Excel file.

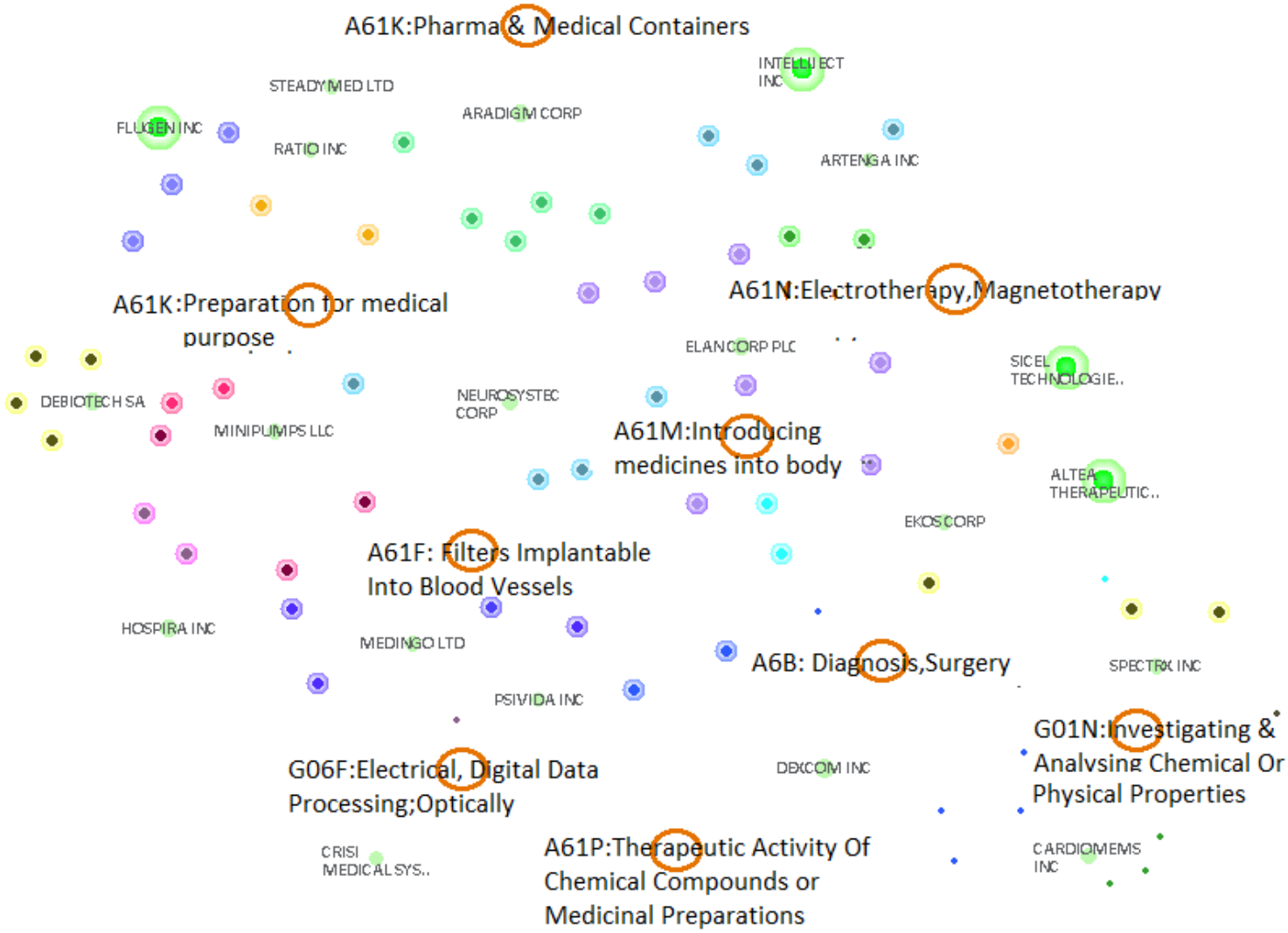
The contour below shows the field of research for the companies wherein most of the research activity is concentrated around pumps, microneedle and medical administration. Ekos Corp concentrates only on Ultrasound technology; it can be seen as a different cluster as it's unrelated to other clusters.

How we did it?

The companies were loaded on the map using Analyze By option. They were then expanded on the basis of categories created and then contextually clustered (using Title, Abstract, Claims as the text) using the 'Context Mode' option to generate its technology landscape. (The contour based thematic coloring option is automatically enabled in the Context mode in VizMAP.) We removed unrelated patents using the "Hide Unrelated records" option.

Upcoming Company Portfolio spread across main IPC

- The generated map below highlights activity assignees across top IPC.
- It can be seen that most of the companies have research activity across A61M.



How we did it?

We filtered records for the upcoming companies using the analyze option in Vizmap. These records were then expanded by IPC to generate the above map.

Appendix A: Search Strings Used for Categorization

Categorization: Sensors

1. Amperometric

Amperometric	
(TAC) contains (amperomet* w/5 sens*)	48 results

2. Bio Sensors

Bio Sensors	
(TAC) contains ((bio* w/5 sens*) and not (biolog* or biopsy* biofouling or biodegrad* or biomolecule* or biofeedback))	51 results

3. Calorimetric

Calorimetric	
(TAC) contains (calorimet* w/5 sens*)	14 results

4. Electro-Optic

Electro-Optic	
(TAC) contains ((electro-optic* or electrooptic* or "electro optic*") w/5 sens*)	11 results

5. Flow

Flow	
(TAC) contains (flow* w/5 sens*)	145 results

6. Glucose

Glucose	
(TAC) contains (glucose* w/5 sens*)	127 results

7. Impedance

Impedance	
(TAC) contains (impedance* w/5 sens*)	73 results

8. Photo-Reflective

Photo-Reflective	
(TAC) contains (photo* w/5 sens*)	55 results

9. Pressure

Pressure	
(TAC) contains (pressure* w/5 sens*)	431 results

10. Temperature

Temperature	
(TAC) contains (temperature* w/5 sens*)	256 results

Categorization: Microneedle

1. Hollow

Hollow	
(TAC) contains (hollow* w/5 (micro-needle* or microneedle* or "micro needle" or needle*))	95 results

2. Porous

Porous	
(TAC) contains (porous w/5 (micro-needle* or microneedle* or "micro needle" or needle*))	34 results

3. Solid

Solid	
(TAC) contains (solid* w/5 (micro-needle* or microneedle* or "micro needle" or needle*))	30 results

4. Stacked Configuration

Stacked Configuration	
(TAC) contains (Stacked* w/5 (micro-needle* or microneedle* or "micro needle" or needle*))	7results

Categorization: Micropump

1. Osmotic

Osmotic	
(TAC) contains (osmotic* w/5 (diuretic or dispenser* or dose* or dosage* or pump* or micropump* or "micro* pump*" or ((micro or mini) w/3 pump*) or minipump*) or ((electroosmotic or "electro osmotic") w/2 pump*) or "EOP" or "EO pump")	61 results

2. Piezoelectric

Piezoelectric	
(TAC) contains ((piezoelectric* or piezo-electric* or piezo*) and (micropump* or micro-pump* or "micro pump*" or minipunp* or "minp-pump*" or pump*))	29 results

3. Valve

Valve	
(TAC) contains ((valve*) w/5 (micropump* or micro-pump* or "micro pump*" or minipump or "mini*pump" pump*))	85 results

Categorization: Methods- Drug Delivery

1. External

External	
(TAC) contains (external* w/5 ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infus* or diffus* or perfus* or releas* or syringe* or implant*)))	252 results

2. Internal

Internal	
(TAC) contains (internal* w/5 ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infus* or diffus* or perfus* or releas* or syringe* or implant*)))	81 results

3. Programmable

Programmable	
(TAC) contains (programmable* w/5 ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infus* or diffus* or perfus* or releas* or syringe* or implant*)))	59 results

4. Timed

Timed	
(TAC) contains (timed* w/5 ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infus* or diffus* or perfus* or releas* or syringe* or implant*)))	19 results

Categorization: Communication

1. Bluetooth

Bluetooth	
(TAC) contains ((bluetooth* or “blue-tooth”) w/5 communicat*)	8 results

2. Optical

Optical	
(TAC) contains ("optical*" w/5 communicat*)	25 results

3. Radio Frequency

Radio Frequency	
(TAC) contains (("radio frequency" or RF or "radio-frequency*") w/5 communicat*)	47 results

4. Wireless

Wireless	
(TAC) contains (wireless* w/5 communicat*)	190 results

Categorization: Applications

1. Atherosclerosis

Atherosclerosis	
(TAC) contains (atherosclerosis* and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*)))	26 results

2. Blood Infection

Blood Infection	
(TAC) contains (blood and infect*) and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	92 results

3. Cancer

Cancer	
(TAC) contains (cancer* or (malignant w/3 neoplasm) or Hyperplasia or Cyst or Pseudocyst or Hamartoma or Dysplasia or "Carcinoma in situ" or Metastasis) and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	221 results

4. Cardiac

Cardiac	
(TAC) contains ((cardiac* and heart) and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*)))	175 results

5. Coronary Artery Disease

Coronary Artery Disease	
(TAC) contains ((coronary* w/5 arter*) or myocardium* or "cardiac vein*" or ischemia or tricuspid or mitral or systole) and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	105 results

6. Dermal Disorder

Dermal Disorder	
(TAC) contains (dermal* or Fibroblasts* or Macrophages* or Adipocyte* or dermis* or corium) and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	127 results

7. Diabetes

Diabetes	
(TAC) contains (mellitus or diabetes or (insulin w/3 pump) or "NIDDM" or "IDDM" or polyuria or polydipsia or polydipsia or Kussmaul) and ((drug* or pharma* or	157 results

medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	

8. Hypertension

Hypertension	
(TAC) contains (hypertension or (high w/3 pressure) or (arterial w/3 hypertension)) and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	120 results

9. Muscle

Muscle	
(TAC) contains (muscle* and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*)))	213 results

10. Neurological

Neurological	
(TAC) contains (neurologic* w/5 ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*)))	5 results

11. Peripheral Vascular Disease

Peripherical Vascular Disease	
(TAC) contains (vascular* w/5 disease*) and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	31 results

12. Skin

Skin	
(TAC) contains "skin" and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	518 results

13. Traversing Alimentary Tract

Traversing Alimentary Tract	
(TAC) contains (traversing* w/3 alimentary*) and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	2 results

14. Vaccination

Vaccination	
(TAC) contains (vaccinat*) and ((drug* or pharma* or medic*) w/3 (inject* or deliver* or infuse* or diffuse* or perfuse* or releas* or syringe* or implant*))	9 results

Appendix B: List of Patents for Upcoming Companies in this technology

Patent Number	Title	Assignees	Filing Date	Abstract
AU2001279072	Closed-loop flow control for IV fluid delivery	HOSPIRA INC	27/Jul/2001	In a closed-loop process, a controller uses a flow sensor to monitor the flow of a medicinal fluid being infused into a patient, to achieve a desired rate of flow. A relatively inexpensive peristaltic pump or electronically controlled valve can be used to vary the flow of the medicinal fluid through a fluid line. A Y site within the fluid line includes an integral flow sensor having an orifice. The flow sensor includes proximal and distal pressure sensors disposed on opposite sides of the orifice to monitor the distal and proximal pressure, producing a signal indicative of the rate of flow of the medicinal fluid through the fluid line. A signal produced by the controller is input to a motor driving the pump or to the valve to vary the rate of flow as required to achieve the desired infusion rate of the medicinal fluid. [WO0209795A2]
AU2002248586	Disposable infusion cassette with low air bubble retention and improved valves	HOSPIRA INC	11/Mar/2002	A disposable cassette for use with a medical infusion pump. An elastomeric membrane is captured between a facing member and a base of the cassette and is displaced into a pumping chamber. The elastomeric membrane includes a generally T-shaped lip, and corresponding grooves are provided on the facing member and base. As the cassette is assembled, an interference fit between the lip and the grooves causes the membrane to stretch taut and to be securely anchored, eliminating a break-in period when the cassette is initially used. "Lobes" of increased thickness provided on the undersurface of a portion of the elastomeric membrane overlying the pumping chamber reduce the residual volume of the pumping chamber, thereby reducing the volume of air retained within the chamber and increasing the accuracy of the cassette. The lobes also sweep air bubbles from the sides of the pumping chamber during operation, further reducing air bubbles retained in the pumping chamber. A distal tube support retains a distal fluid line between air or pressure sensors included on a pump drive mechanism, thus reducing the likelihood of sensing errors. Inlet and outlet valve flaps and corresponding seating surfaces included in the base are configured to provide quieter operation, further reduce the residual volume of the pumping chamber, increase fluid velocity through the outlet valve to sweep air bubbles from the pumping chamber, and protect against a "blown" inlet valve. [US2002159900A1]

AU2002361897	PULMONARY DELIVERY OF AMINOGLYCOSIDES	NEKTAR THERAPEUTICS	19/Dec/2002	The present invention is directed to the administration of aminoglycosides. In particular, the present invention is directed to compositions and methods for the pulmonary administration of aminoglycosides. According to a preferred embodiment, compositions and methods are provided for the localized treatment of respiratory infections. [WO03053411A1]
AU2004201488	Fluid management in a continuous fluid collection and sensor device	ALTEA THERAPEUTICS CORP,SPECTRX INC	07/Apr/2004	None
AU2004214420	In vivo fluorescence sensors, systems, and related methods operating in conjunction with fluorescent analytes	SICEL TECHNOLOGIES INC	17/Feb/2004	Methods, systems, devices and computer program product include: (i) administering a fluorescent analyte to a subject; (ii) repetitively emitting excitation light from an implanted sensor over a desired monitoring period; (iii) detecting fluorescence intensity in response to the excitation light using the implanted sensor that outputs the excitation light; and (iv) using data associated with the detected fluorescence intensity to perform at least one of: (a) calculate the concentration or dose of the analyte received proximate to the implanted sensor site; (b) evaluate the pharmacodynamic or pharmacokinetic activity of the fluorescent analyte; (c) confirm Ab attachment to a tumor site; (d) monitor a non-target site to confirm it is not unduly affected by a therapy; (e) monitor for changes in cellular properties; (f) use the calculated dose or concentration data to adjust or customize a therapeutic amount of the analyte administered to the subject; (g) confirm micelle concentration at a target site and then stimulate toxin release based on the confirmation; and (h) monitor for the expression of a protein produced from a gene therapy modification. In particular embodiments, the intensity of the excitation signals emitted to the localized tissue can be varied in a predetermined manner to generate optical profiling data of the response of the tissue proximate the sensor. [WO2004075032A2]
AU2004284914	Method for transdermal delivery of permeant substances	ALTEA THERAPEUTICS CORP	21/Oct/2004	A method for delivering permeant substances transdermally into a membrane of an animal includes forming at least one delivery opening in the skin tissue, with the at least one delivery opening having a mean opening depth of between about 40 and about 90 microns. [US2005090800A1]

AU2006262233	Method and apparatus for delivering an implantable wireless sensor for in vivo pressure measurement	CARDIOMEMS INC	21/Jun/2006	An apparatus for implanting an implant device having a corkscrew-type anchor associated therewith into a patient includes an elongated, flexible shaft. A retention mechanism is located at the distal end of the shaft for retaining the device at the distal end of the shaft. The apparatus includes means selectively operable for disengaging the retention mechanism from the implant device when the anchor has been anchored into tissue at a target site. In another aspect, an apparatus for releasing an implant into a vessel within a patient includes an elongated shaft for inserting into the vessel of the patient. A tether wire extends through the proximal portion of a secondary lumen, exits a first port, engages a portion of the implant, enters a second port, and extends through at least a portion of a distal portion of the secondary lumen. The implant is thereby tethered to the side of the elongated shaft, and pulling the tether wire disengages the tether wire from the distal portion of the secondary lumen and the implant so as to release the implant from the shaft. [WO2007002224A2]
AU2006262234	Implantable wireless sensor for in vivo pressure measurement	CARDIOMEMS INC	21/Jun/2006	A sensor suitable for in vivo implantation has a capacitive circuit and a three-dimensional inductor coil connected to the capacitive circuit to form an LC circuit. The LC circuit is hermetically encapsulated within an electrically insulating housing. An electrical characteristic of the LC circuit is responsive to a change in an environmental parameter. [US2006287602A1]
AU2007248475	Implantable wireless sensor for in vivo pressure measurement and continuous output determination	CARDIOMEMS INC	04/May/2007	A method and apparatus for determining cardiac parameters within the body of a patient includes a wireless sensor positioned in the patients pulmonary artery. An external RF telemetry device communicates wirelessly with the sensor and interrogates the sensor to determine changes in pressure in the pulmonary artery over time. The peak pressure difference is determined. Then, assuming zero blood flow velocity at the time of valve opening and at the time of valve closing, a velocity-time function is determined. The velocity-time function is used to determine a velocity-time integral. The velocity-time integral is then used to determine cardiac stroke volume. The cardiac stroke volume is multiplied times the heartbeat rate to determine cardiac output. The cardiac output can be monitored over time to determine continuous cardiac output. [WO2007130628A2]
AU2007270770	Medical device for administering a solution	DEBIOTECH SA	18/Jun/2007	The device has a communication unit allowing communication between a reservoir and a pumping unit, where the reservoir contains medical solution i.e. insulin, and a patient line adapted for connecting the device to a patient. A determination unit determines physico-chemical characteristics e.g. evaporation characteristics, of the solution based on time by using a mathematical model. A variation unit varies the administration of the solution based on a variation of concentration of the determined

				solution. [EP1875933A1]
AU2007286645	System and method for improved low flow medical pump delivery	HOSPIRA INC	23/Aug/2007	A medical pump with an improved continuity low flow delivery system and method for use with a pumping chamber, for example in a cassette, is disclosed. The pump includes a pump drive for exerting a force on the pumping chamber and a sensor for sensing the force/pressure exerted by the pump drive on the pumping chamber. The pump drive position sensor senses the position of the pump drive. The medical pump also includes a processing unit and a memory having a programming code adapted to calculate the rate of change of the sensed force/pressure values and determine whether the rate of change of the sensed force/pressure values meets a rate of change threshold. Once the rate of change threshold is met, the programming code is adapted to calculate a remaining pump drive travel value for determining how much farther the pump drive should travel before the end of an effective pump cycle. The programming code is further adapted to trigger one or more signals to drive the pump drive for the remainder of the effective pump cycle using the remaining pump drive travel value. [US2007058412A1]
AU2007294526	Physiological data acquisition and management system for use with an implanted wireless sensor	CARDIOMEMS INC	10/Sep/2007	Aspects and embodiments of the present invention provide a system for obtaining, processing and managing data from an implanted sensor. In some embodiments, a patient or other persons can use a flexible antenna to obtain data from the implanted sensor. The flexible antenna includes at least one transmit loop and at least one receive loop. The transmit loop is adapted to propagate energizing signals to the implanted sensor. The receive loop is adapted to detect a response signal from the implanted sensor. The transmit loop includes a capacitor formed by a discontinuous area. The capacitor is adapted to allow the loop to be tuned. The flexible antenna can communicate with a patient device that collects the data from the implanted sensor, creates a data file and transmits the data file to a remote server over a network. A physician or other authorized person may access the remote server using an access device. [WO2008031095A1]
AU2008227836	User interface for selecting bolus doses in a drug delivery device	MEDINGO LTD	19/Mar/2008	An apparatus and system for selecting a bolus dose of a drug in a drug delivery device is disclosed. A bolus dose is selected from a pre-determined schedule of bolus doses, wherein each dose corresponds to a range of a body analyte levels. [WO2008114254A1]

AU2009311600	Fluid medication delivery systems for delivery monitoring of secondary medications	HOSPIRA INC	10/Jun/2009	A fluid medication delivery system comprises a primary medication reservoir, a secondary medication reservoir, an infusion pump, a first valve assembly, a second valve assembly, a first y-site, and a fluid flow sensor assembly. The primary medication reservoir has a first fluid. The secondary medication reservoir has a second fluid. The infusion pump pumps fluid from at least one of the primary medication reservoir and the secondary medication reservoir. The first valve assembly controls the flow of fluid from the primary medication reservoir in a first fluid line segment. The second valve assembly controls the flow of fluid from the secondary medication reservoir in a second fluid line segment. The fluid flow sensor assembly determines the flow rate of a fluid from the secondary medication reservoir in the second fluid line segment. [US2010114027A1]
AU2010231527	Devices and methods for enhancing drug absorption rate	MEDINGO LTD	06/Apr/2010	Devices, systems and methods directed to a drug delivery device including a soft subcutaneously insertable cannula are disclosed. Some embodiments of the cannula include an elongated soft tube having a plurality of apertures spaced around and/or along a wall of the elongated soft tube. The plurality of apertures is configured for fluid flow therethrough resulting-in/causing an increase in an absorption rate of the fluid in the body of the user. The drug delivery device can be an insulin pump.
AU2010246067	Porous silicon drug-eluting particles	PSIVIDA INC	04/May/2010	The invention provides a biodegradable drug-eluting particle useful for the delivery of diagnostic or therapeutic agents. In certain embodiments, the drug-eluting particle of the invention comprises a biodegradable porous silicon body, a reservoir formed within the porous silicon body having at least one opening to an exterior of the body, wherein the reservoir contains a therapeutic or diagnostic agent, and an agent- permeable seal disposed over the at least one opening. The invention further provides a method for treating a patient to obtain a desired local or systemic physiological or pharmacological effect comprising administering a sustained release drug delivery particle of the invention. The invention also provides methods of fabricating a drug- eluting particle for releasing therapeutic agents.
AU2010284216	Electrolytic drug-delivery pump with adaptive control	MINIPUMPS LLC	18/Aug/2010	Actuation of a drug-delivery pump is controlled based on a change in a condition of the pump.

AU2011203724	Drug delivery device	FLUGEN INC,RATIO INC	04/Jan/2011	A drug delivery device for delivering a drug to a subject includes a microneedle configured to facilitate delivery of the drug to the subject. The microneedle includes a tip portion and is moveable from an inactive position to an activated position. When the microneedle is moved to the activated position, the tip portion of the microneedle is configured to penetrate the skin of the subject to provide drug delivery into the skin of the subject.
AU2012201481	Devices, systems, and methods for medicament delivery	INTELLIJECT INC	13/Mar/2012	Certain exemplary embodimets can comprise an auto-injector (1000), which can comprise: a vial (4300) configured to store and/or contain an injectable medicament, the vial defining a vial longitudinal axis, and a housing (1800) comprising the vial. In various embodiments, the injectable medicament can be a medicine, medication, drug, pharmaceutical, prescriptive, agent, antidote, anti-veno hormone, stimulant, vasodilator, anesthetic, and/or nutritional supplement that is substantially ready for injection.
AU685694	Creating an aerosolized formulation of insulin	ARADIGM CORP	27/Oct/1995	Devices, packaging and methodology for efficiently and repeatably creating aerosolized bursts of an insulin containing formulation are disclosed. Devices are hand-held, self-contained units which are automatically actuated at the same release point in a patients inspiratory flow cycle. The release point is automatically determined either mechanically or, more preferably calculated by a microprocessor which receives data from a sensor making it possible to determine inspiratory flow rate and inspiratory volume. Actuation of the device forces insulin formulation through a porous membrane (3) of the container (1) which membrane has pores having a diameter in the range of about 0.25 to 3.0 microns, preferably 0.25 to 1.5 microns. [WO9613161A1]
AU693279	Analyte-controlled liquid delivery device and analyte monitor	ELAN CORP PLC	27/Oct/1995	A liquid delivery device (40) comprising a housing (41) having a lower surface (51) for application to the skin of a subject and having a reservoir (42) and a gas generation chamber (43) therein separated by a displaceable membrane (45). Gas generated by an electrolytic cell (44) under the control of a microprocessor (46) causes the gas generation chamber (43) to expand and the reservoir (42) to contract, thereby discharging a liquid drug, such as insulin, from the reservoir via a hollow delivery needle (49) extending from the lower surface (51). The delivery needle (49) and a sensor needle (48) both extend from the lower surface a sufficient distance so as to penetrate through the epidermis and into the dermis when the housing is pressed against the skin. The sensor needle (48) has an enzymatic coating for the detection of an analyte, such as glucose in the subjects plasma. The delivery needle (49) is made of platinum-iridium, and a current passes between the needles (48, 49) and a potentiostat circuit (47) according to the amount of glucose detected. A reference electrode (silver/silver

				chloride) (50) which rests against the subjects skin increases the accuracy of the glucose measurement. The current through the potentiostat circuit (47) is measured by a voltmeter (53) and a signal from the voltmeter (53) is amplified and communicated to the microprocessor (46) which determines the correct rate of delivery of the drug on the basis of the level of analyte detected in the subjects plasma. [WO9614026A1]
AU734896	Medical device for injecting liquid	DEBIOTECH SA	18/Dec/1997	The invention concerns a device for injecting liquid comprising a connection piece on which is located at least a first liquid occlusion system (7). The invention is characterised in that a regulating system (4) is located upstream of the first occlusion system, the two systems defining an intermediate segment in which the pressure, in the absence of injection, is higher than the pressure prevailing downstream of the first occlusion system for directing downstream any leak at the first occlusion system. The invention is applicable to a pump used for injecting contrast liquid for medical imaging. [FR2757069A1]
AU741913	Device for administering insulin in controlled dosages by controlling total inhaled volume	ARADIGM CORP	23/Apr/1998	Dosages of inhaled insulin are controlled within a narrow range by controlling the total volume of air inhaled by a patient. By repeatedly delivering aerosolized insulin with the same total inhaled volume of air, the amount of insulin delivered to the patient each time is consistent. A device (40) comprises a means (11, 29) for measuring inhaled volume and for halting inhalation at a predetermined point. The device also comprises an adjustable means (9) for applying various amounts of force to a container (1) of formulation (5) to expel different amounts of drugs from the container based on the force applied. [WO9848873A1]
AU770388	Fluid management in a continuous fluid collection and sensor device	ALTEA THERAPEUTICS CORP,SPECTRX INC	20/Jul/1999	A fluid collection and sensor device for placement over at least one artificial opening made in a biological membrane for measuring a characteristic of a biological fluid collected from the tissue through the at least one artificial opening. The device comprises a sensor (110) positioned in a flow path (105) of the biological fluid for contacting a quantity of the biological fluid and generating an indication of a characteristic of the biological fluid. According to one aspect of the invention, a waste fluid storage element (120), such as a reservoir, is positioned in the device (100) to collect the biological fluid after it has made contact with the sensor (110). According to another aspect of the invention, various surfaces of the fluid flow path (105) of the fluid collection and sensor device (100) are treated with an agent to limit or minimize clotting, aggregation or sepsis of the biological fluid, blockage or clogging of the flow path (105) or degradation of the sensor (110). According to still another aspect of the invention, various configurations of a fluid sensor and collection device (100) are provided that are designed to ensure that measurements

				are made on independent fluid samples. [WO0004821A1]
AU780752	Apparatus for microporation of biological membranes using thin film tissue interface devices, and method therefor	ALTEA THERAPEUTICS CORP	08/Jun/2000	The invention provides for improved devices and methods for forming openings in a biological membrane for delivering substances into an animal through the biological membrane for treatment applications, or extracting substances from the animal through the biological membrane for monitoring or other diagnosis applications and for increased transmembrane flux. [WO0074767A2]
CA2577457	MICROBUBBLE MEDICAL DEVICES	ARTENGA INC	06/Feb/2007	Method and medical devices for generating and stabilizing micro or nano bubbles, and systems and methods for therapeutic applications using the bubbles, is provided. Two novel bubble generating means are provided: in-line capillary tubes and mix chambers flow focusing, and cross flow bubble generation with optimized bubb le detachment means. A method and medical device to stabilize bubble sizes and improve bubble size homogeneity through rectified diffusion is disclosed. A method and system to facilitate acoustic activation of therapeutic agents using ultrasound energy is provided. Methods, systems, selected additives, and devices to permit therapeutic benefits such as ultrasound-guided precision drug delivery and real-time verification, acoustic activation of large tumour masses while avoiding acoustic shadowing, enhance d acoustic activation through longer retention of therapeutic agents at the point of interest, on demand means to combine inertial and non-inertial acoustic activation in a single treatment, enhancement of high intensity focused ultrasound treatment s, light activation of photodynamic drugs at a depth within a patient using extracorporeal light sources, probes, or sonoluminescence, and initiation of time reversal acoustics focused ultrasound to permit highly localized treatment, are provided.</SDOA B>
CA2657380	DEVICES, SYSTEMS AND METHODS FOR OPHTHALMIC DRUG DELIVERY	NEUROSYSTEC CORP	20/Jul/2007	Devices, systems and techniques for delivering drugs to an ocular tissue are described. In at least some embodiments, a terminal component (e.g., a n eedle or open end of a catheter) is implanted in an ocular tissue and used t o deliver one or more drugs. The delivered drugs may come from a source whic h is also implanted, or may be introduced from an external source (e.g., via a port). Both solid and liquid drug formulations can be used. Ocular implan ts can alternatively include a thin film coating that releases a drug into a n ocular tissue.
CN101528283	Apparatus and method for delivering therapeutic and/or other agents to the inner ear and to other tissues	NEUROSYSTEC CORP	24/Jan/2006	The present invention discloses an apparatus may include a needle for sustained delivery of drugs and other agents to the inner ear or other tissues of a human or an animal. The needle can include an insertion stop, and can be placed through the round window membrane or through a surgically-prepared hole in a bone. The needle can be in fluid communication with a port and/or with a micro-infusion or osmotic pump. A cochlear implant electrode can be used

				instead of a needle.
EP1381395	SYSTEMS, METHODS AND DEVICES FOR IN VIVO MONITORING OF A LOCALIZED RESPONSE VIA A RADIOLABELED ANALYTE IN A SUBJECT	SICEL TECHNOLOGIES INC	23/Apr/2002	Methods, systems, devices and computer program products monitor in vivo detected radiation in a target localized site within a subject, over a selected time period, to do one or more of: (a) quantify a radiation dose received at a local site; (b) assess bioreceptiveness to a particular treatment time or type; (c) evaluate the pharmacokinetics of a radiolabeled analyte corresponding to a non-radiolabeled analyte; (d) monitor or evaluate metabolic activity; or (e) evaluate a tumor prior to or after a therapeutic treatment. [WO02086449A2]
EP1695734	Microneedles for minimally invasive drug delivery or for diagnostic sampling	HOSPIRA INC	22/May/2002	The present invention provides a microneedle incorporating a base that is broad relative to a height of the microneedle, to minimize breakage. The microneedle further includes a fluid channel and a beveled non?coring tip. Preferably arrays of such microneedles are fabricated utilizing conventional semiconductor derived micro?scale fabrication techniques. A dot pattern mask is formed on an upper surface of a silicon substrate, with each orifice of the dot pattern mask corresponding to a desired location of a microneedle. Orifices are formed that pass completely through the substrate by etching. A nitride pattern mask is formed to mask all areas in which a nitride layer is not desired. A nitride layer is then deposited on the bottom of the silicon substrate, on the walls of the orifice, and on the top of the silicon substrate around the periphery of the orifice. The nitride layer around the periphery of the orifice is offset somewhat, such that one side of the orifice has a larger nitride layer. Anisotropic etching is used to remove a substantial portion of the substrate, creating a plurality of angular, blunt, and generally pyramidal-shaped microneedles. A subsequent removal of the nitride layer, followed by an isotropic etching step, softens and rounds out the blunt angular microneedles, providing generally conical-shaped microneedles. The uneven nitride layer adjacent the orifice ensures that the microneedles will include a beveled tip. Such microneedle arrays are preferably incorporated into handheld diagnostic and drug delivery systems. [WO02100474A2]
EP1861161	APPARATUS AND METHOD FOR DELIVERING THERAPEUTIC AND/OR OTHER AGENTS TO THE INNER EAR AND TO OTHER TISSUES	NEUROSYSTEC CORP	24/Jan/2006	An apparatus may include a needle for sustained delivery of drugs and other agents to the inner ear or other tissues of a human or an animal. The needle can include an insertion stop, and can be placed through the round window membrane or through a surgically-prepared hole in a bone. The needle can be in fluid communication with a port and/or with a micro-infusion or osmotic pump. A cochlear implant electrode can be used instead of a needle. [US2006264897A1]

EP2058020	Devices for medicament delivery	INTELLIJECT INC	01/Feb/2006	An apparatus (1000) comprising: a housing (1100); a medicament delivery mechanism configured to be disposed within the housing; and an electronic circuit system configured to be coupled to the housing, the electronic circuit system further configured to produce an output. [EP2058020A2]
EP2152350	INTEGRATED MEDICAMENT DELIVERY DEVICE FOR USE WITH CONTINUOUS ANALYTE SENSOR	DEXCOM INC	05/Jun/2008	An integrated system for the monitoring and treating diabetes is provided, including an integrated receiver/hand-held medicament injection pen, including electronics, for use with a continuous glucose sensor. In some embodiments, the receiver is configured to receive continuous glucose sensor data, to calculate a medicament therapy (e.g., via the integrated system electronics) and to automatically set a bolus dose of the integrated hand-held medicament injection pen, whereby the user can manually inject the bolus dose of medicament into the host. In some embodiments, the integrated receiver and hand-held medicament injection pen are integrally formed, while in other embodiments they are detachably connected and communicated via mutually engaging electrical contacts and/or via wireless communication. [US2008306434A1]
EP2232216	DIFFERENTIAL PRESSURE BASED FLOW SENSOR ASSEMBLY FOR MEDICATION DELIVERY MONITORING AND METHOD OF USING THE SAME	HOSPIRA INC	17/Dec/2008	A differential pressure based flow sensor assembly and method of using the same to determine the rate of fluid flow in a fluid system. The sensor assembly comprises a disposable portion, and a reusable portion. A flow restricting element is positioned along a fluid flow passage between an inlet and an outlet. The disposable portion further has an upstream fluid pressure membrane and a downstream fluid pressure membrane. The reusable portion has an upstream fluid pressure sensor and a downstream fluid pressure sensor. The upstream fluid pressure sensor senses the upstream fluid pressure at a location within the fluid flow passage between the inlet and the flow restricting element. The downstream fluid pressure sensor senses the downstream fluid pressure at a location within the fluid flow passage between the flow restricting element and the outlet. The process utilizes output of the sensors to calculate the flow rate of the fluid. [US2009157040A1]
EP2252196	SYSTEMS AND METHODS FOR PROCESSING, TRANSMITTING AND DISPLAYING SENSOR DATA	DEXCOM INC	20/Feb/2009	Systems and methods for continuous measurement of an analyte in a host are provided. The system generally includes a continuous analyte sensor configured to continuously measure a concentration of analyte in a host and a sensor electronics module physically connected to the continuous analyte sensor during sensor use, wherein the sensor electronics module is further configured to directly wirelessly communicate displayable sensor information to a plurality of different types of display devices. [WO2009105709A1]

EP2496283	MEDICATION INJECTION SITE AND DATA COLLECTION SYSTEM	CRISI MEDICAL SYSTEMS INC	03/Nov/2010	A medication delivery apparatus for use with a medication container includes a housing, a fluid conduit at least partially extending within the housing and configured to deliver medication within the medication container to a patient, a medication port extending from the housing and configured to be coupled to a fluid outlet of the medication container, the medication port being fluidically coupled to the fluid conduit, and at least one sensor disposed within the housing to generate information characterizing administration of the medication for processing by a remote data collection system. The housing can have a size and shape that enables it to be supported by a first hand of a user while the user administers the medication from the medication container via the medication port using a second hand of the user. Related apparatus, systems, kits, and techniques are also described. [WO2011056888A2]
US20040199059	Optimized sensor geometry for an implantable glucose sensor	DEXCOM INC	22/Aug/2003	An implantable sensor for use in measuring a concentration of an analyte such as glucose in a bodily fluid, including a body with a sensing region adapted for transport of analytes between the sensor and the bodily fluid, wherein the sensing region is located on a curved portion of the body such that when a foreign body capsule forms around the sensor, a contractile force is exerted by the foreign body capsule toward the sensing region. The body is partially or entirely curved, partially or entirely covered with an anchoring material for supporting tissue ingrowth, and designed for subcutaneous tissue implantation. The geometric design, including curvature, shape, and other factors minimize chronic inflammatory response at the sensing region and contribute to improved performance of the sensor in vivo.
US20080107720	Topical delivery of codrugs	PSIVIDA INC	04/Jan/2008	The present invention provides pharmaceutical compositions for topical delivery comprising a suitable carrier and a codrug capable of penetrating, or being transported across, the dermis. The codrug according to the invention comprises a first constituent moiety linked to a second constituent moiety, wherein the second constituent moiety is the same as, or different from, the first constituent moiety. The first and second constituent moieties are so linked that they are easily transported into or across the dermis, into the skin, or into the blood or lymphatic system, and are reconstituted in vivo to form the first and second constituent moieties.
US20080195232	BIOINTERFACE WITH MACRO- AND MICRO-ARCHITECTURE	DEXCOM INC	15/Apr/2008	Disclosed herein are biointerface membranes including a macro-architecture and a micro-architecture co-continuous with and bonded to and/or located within at least a portion of the macro-architecture. The macro- and micro-architectures work together to manage and manipulate the high-level tissue organization and the low-level cellular organization of the foreign body response in vivo, thereby increasing neovascularization close to a device-

				tissue interface, interfering with barrier cell layer formation, and providing good tissue anchoring, while reducing the effects of motion artifact, and disrupting the organization and/or contracture of the FBC. The biointerface membranes of the preferred embodiments can be utilized with implantable devices such as devices for the detection of analyte concentrations in a biological sample (for example, from a body), cell transplantation devices, drug delivery devices, electrical signal delivering or measuring devices, and/or combinations thereof.
US20080287765	INTEGRATED RECEIVER FOR CONTINUOUS ANALYTE SENSOR	DEXCOM INC	29/Jul/2008	A system is provided for monitoring glucose in a host, including a continuous glucose sensor that produces a data stream indicative of a hosts glucose concentration and an integrated receiver that receives the data stream from the continuous glucose sensor and calibrates the data stream using a single point glucose monitor that is integral with the integrated receiver. The integrated receiver obtains a glucose value from the single point glucose monitor, calibrates the sensor data stream received from the continuous glucose sensor, and displays one or both of the single point glucose measurement values and the calibrated continuous glucose sensor values on the user interface.
US20090192366	SYSTEMS AND METHODS FOR PROCESSING SENSOR DATA	DEXCOM INC	24/Oct/2008	Systems and methods for processing sensor data are provided. In some embodiments, systems and methods are provided for calibration of a continuous analyte sensor. In some embodiments, systems and methods are provided for classification of a level of noise on a sensor signal. In some embodiments, systems and methods are provided for determining a rate of change for analyte concentration based on a continuous sensor signal. In some embodiments, systems and methods for alerting or alarming a patient based on prediction of glucose concentration are provided.
US20090192380	SYSTEMS AND METHODS FOR PROCESSING SENSOR DATA	DEXCOM INC	24/Oct/2008	Systems and methods for processing sensor data are provided. In some embodiments, systems and methods are provided for calibration of a continuous analyte sensor. In some embodiments, systems and methods are provided for classification of a level of noise on a sensor signal. In some embodiments, systems and methods are provided for determining a rate of change for analyte concentration based on a continuous sensor signal. In some embodiments, systems and methods for alerting or alarming a patient based on prediction of glucose concentration are provided.
US20090203981	SIGNAL PROCESSING FOR CONTINUOUS ANALYTE SENSOR	DEXCOM INC	15/Apr/2009	Systems and methods for dynamically and intelligently estimating analyte data from a continuous analyte sensor, including receiving a data stream, selecting one of a plurality of algorithms, and employing the selected algorithm to estimate analyte values. Additional data processing includes evaluating the selected estimative algorithms, analyzing a variation of the estimated analyte values based on statistical, clinical, or physiological parameters, comparing

				the estimated analyte values with corresponding measure analyte values, and providing output to a user. Estimation can be used to compensate for time lag, match sensor data with corresponding reference data, warn of upcoming clinical risk, replace erroneous sensor data signals, and provide more timely analyte information encourage proactive behavior and preempt clinical risk.
US20090299156	CONTINUOUS MEDICAMENT SENSOR SYSTEM FOR IN VIVO USE	DEXCOM INC	04/Feb/2009	Systems and methods for continuous measurement of a medicament in vivo are provided. In some embodiments, the system is configured to provide information associated with medicament titration and includes a continuous analyte sensor and a communication device. In some embodiments, the system is configured for continuous ambulatory drug testing, including an ambulatory host monitor having a continuous sensor, a location module, a processor module and a transmitter. In some embodiments, the system is configured for continuously monitoring a hormone level and includes a continuous hormone sensor and a communication device configured to output hormone information in real time. Yet another embodiment provides an analyte sensor for continuous monitoring of a hosts nutritional status, and is configured for both continuous glucose detection and continuous albumin detection.
US20100022992	Drug Delivery Device	STEADYMED LTD	06/May/2007	The present application provides a drug-delivery device comprising a drug reservoir chamber 16, containing a substance to be delivered, in fluid connection with a drug administration means 18, and an electrically-controlled battery unit 10 comprising at least one displacement-generating battery cell 19 coupled to the drug reservoir chamber 16 by a coupling means 14, the arrangement being such that the displacement derived from the battery unit 10 is conveyed by the coupling means 14 to the drug reservoir chamber 16 such that the substance is expelled from the drug reservoir chamber 16 towards the drug administration means 18.
US20100280486	SYSTEM AND METHOD FOR DELIVERING AND MONITORING MEDICATION	HOSPIRA INC	08/Jun/2009	A method of delivering medication to a patient utilizing a medication delivery system is provided. A first medication to be delivered to the patient is supplied. The patients identity is verified. The first medication is selected on a user interface to be delivered to the patient. The volume of the medication the patient will receive is entered. The first medication is injected into the patient through a flow sensor assembly. The flow rate and the volume of the first medication delivered to the patient are monitored by the flow sensor assembly while the injection occurs. A visual display provides information related to the injection. The method updates the patients electronic medical administration record to capture the information regarding the injection of the first medication.

US20110172609	MICRONEEDLE COMPONENT ASSEMBLY FOR DRUG DELIVERY DEVICE	FLUGEN INC,RATIO INC	08/Jan/2010	A device for delivering a drug to a subject is provided. The device includes a drug reservoir, a conduit coupled to the drug reservoir and a microneedle component. The microneedle component includes a body, an engagement structure coupling the microneedle component to the conduit, a hollow microneedle extending from the body, and a handling feature located on the body. The microneedle component is configured to be releasably coupled to an assembly tool via the handling feature during assembly of the device.
US20110172645	WEARABLE DRUG DELIVERY DEVICE INCLUDING INTEGRATED PUMPING AND ACTIVATION ELEMENTS	FLUGEN INC,RATIO INC	08/Jan/2010	A drug delivery device for delivering a drug to a subject is provided. The drug delivery device includes a housing, a drug reservoir supported by the housing containing the drug and a hollow microneedle supported by the housing. The hollow microneedle is moveable from an inactive position to an activated position, wherein, when the hollow microneedle is moved to the activated position, the tip portion of the hollow microneedle is configured to penetrate the skin of the subject. The drug delivery device includes a channel having an input in communication with the drug reservoir and an output in communication with the hollow microneedle. The channel provides fluid communication between the drug reservoir and the hollow microneedle, such that the drug is permitted to flow from the drug reservoir through the channel and through the hollow microneedle. The channel moves from a first position to a second position as the hollow microneedle moves from the inactive position to the activated position, and the position of the drug reservoir relative to the housing remains fixed as the hollow microneedle moves from the inactive position to the activated position.
US20110270188	FILL-STATUS SENSORS FOR DRUG PUMP DEVICES	MINIPUMPS LLC	20/Apr/2011	The filling status of a drug reservoir in a drug pump devices may be determined with mechanical and/or magnetic position sensor associated with a reservoir boundary.
US20120016299	CATHETER DRUG PUMP	MINIPUMPS LLC	19/Jul/2011	A miniaturized drug pump can actively dispense fluid at a controlled (or controllable) flow rate emerging at or near the distal tip of a catheter.
US20120095389	ULTRASOUND CATHETER FOR PROVIDING A THERAPEUTIC EFFECT TO A VESSEL OF A BODY	EKOS CORP	21/Dec/2011	The invention relates to a catheter system. The system comprises a catheter body having a chamber containing a low acoustic impedance medium. The catheter body includes an elongated body with an external surface and an ultrasound transducer having an external side between a first end and a second end. The ultrasound transducer is positioned over the external surface of the elongated body such that the first end is adjacent to the chamber.

US5318557	Medication administering device	ELAN CORP PLC	22/Feb/1993	A medication administering device includes a housing introducible into a body cavity and of a material insoluble in the body cavity fluids, but formed with an opening covered by a material which is soluble in body cavity fluids. A diaphragm divides the interior of the housing into a medication chamber including the opening, and a control chamber. An electrolytic cell in the control chamber generates a gas when electrical current is passed therethrough to deliver medication from the medication chamber through the opening into the body cavity at a rate controlled by the electrical current.
US5480386	Pump assembly for medical use	DEBIOTECH SA	06/Jul/1994	PCT No. PCT/CH93/00222 Sec. 371 Date Jul. 6, 1994 Sec. 102(e) Date Jul. 6, 1994 PCT Filed Sep. 14, 1993 PCT Pub. No. WO94/06491 PCT Pub. Date Mar. 31, 1994.A portable pump assembly for medical uses, and more particularly a portable micropump designed for the parenteral administration of medicamentous solutions includes a first module (2) provided with a container (8) designed for cooperating with a second motor module (4), the functioning of the pump being ensured by the assembling of the two modules. The first module (2) is provided with a removable filtering and sterilizing device (3), fastened to the filling septum orifice (10) of the container and including a filtering sterile plug (25) and a needle (28) surrounded by a flexible sleeve (29). A support arm (33) includes a guiding part (34) for guiding the device (3) when piercing the septurn and an anchoring casing (40) closing the housing (39) for the second module (4). The first module (2) with the device (3) is provided in a sterile sealed pouch. The assembly is very easy to use, and aseptic conditions are guaranteed during the filling of the container (8).
US5527288	Intradermal drug delivery device and method for intradermal delivery of drugs	ELAN CORP PLC	18/Jan/1994	An intradermal drug delivery device for delivering a liquid drug to a subject via the subjects skin includes a housing having a lower surface provided with an adhesive coating for adhering the housing to the subjects skin. An expansible-contractible chamber within the housing defines a reservoir which is expanded upon being filled with the drug and contracted to dispense the drug. A hollow needle extends through the lower surface of the housing and has an inner end which communicates with the reservoir and an outer end which projects outwardly of the housing a short distance to penetrate through the epidermis and into the dermis of the subjects skin when the housing is adhered thereto. The device permits delivery of drugs of relatively large molecular size and at slow rates which can be precisely controlled. A method of delivering a liquid drug intradermally includes adhering the intradermal delivery device to the skin of the subject and activating the means for actively discharging the at least one drug from the reservoir to the subjects skin via the needle.

US5743250	Insulin delivery enhanced by coached breathing	ARADIGM CORP	22/Nov/1996	The need for the delivery of insulin by injection can be reduced or eliminated by a method whereby an aerosolized insulin formulation is delivered to a patients lungs and the rate at which the insulin is absorbed into the blood is increased by the use of an inhale-exhale breathing maneuver. Particles of insulin delivered to the surface of lung tissue will be absorbed into the circulatory system. The rate of absorption is enhanced by instructing the patient to inhale maximally and thereafter exhale maximally. This maneuver causes a spike in the rate at which insulin enters the circulatory system thereby increasing the rate at which glucose is removed from the circulatory system. The insulin may be a dry powder but is preferably in a liquid formulation delivered to the patient from a hand-held, self-contained device which automatically releases an aerosolized burst of formulation. The device includes a sensor which is preferably electronic which measures inspiratory flow and volume which measurement can be used to control the point of drug release. The sensor can also assist the patient in the inhale-exhale maneuver.
US5800420	Analyte-controlled liquid delivery device and analyte monitor	ELAN CORP PLC	19/Dec/1996	A liquid delivery device comprising a housing having a lower surface for application to the skin of a subject and having a reservoir and a gas generation chamber therein separated by a displaceable membrane. Gas generated by an electrolytic cell under the control of a microprocessor causes the gas generation chamber to expand and the reservoir to contract, thereby discharging a liquid drug, such as insulin, from the reservoir via a hollow delivery needle extending from the lower surface. The delivery needle and a sensor needle both extend from the lower surface a sufficient distance so as to penetrate through the epidermis and into the dermis when the housing is pressed against the skin. The sensor needle has an enzymatic coating for the detection of an analyte, such as glucose in the subjects plasma. The delivery needle is made of platinum-iridium, and a current passes between the needles and a potentiostat circuit according to the amount of glucose detected. A reference electrode (silver/silver chloride) which rests against the subjects skin increases the accuracy of the glucose measurement. The current through the potentiostat circuit is measured by a voltmeter and a signal from the voltmeter is amplified and communicated to the microprocessor which determines the correct rate of delivery of the drug on the basis of the level of analyte detected in the subjects plasma.

US5848991	Intradermal drug delivery device and method for intradermal delivery of drugs	ELAN CORP PLC	25/Apr/1997	An intradermal drug delivery device for delivering a liquid drug to a subject via the subjects skin includes a housing having a lower surface provided with an adhesive coating for adhering the housing to the subjects skin. An expansible-contractible chamber within the housing defines a reservoir which is expanded upon being filled with the drug and contracted to dispense the drug. A hollow needle extends through the lower surface of the housing and has an inner end which communicates with the reservoir and an outer end which projects outwardly of the housing a short distance to penetrate through the epidermis and into the dermis of the subjects skin when the housing is adhered thereto. The device permits delivery of drugs of relatively large molecular size and at slow rates which can be precisely controlled. A method of delivering a liquid drug intradermally includes adhering the intradermal delivery device to the skin of the subject and activating the means for actively discharging the at least one drug from the reservoir to the subjects skin via the needle.
US5915378	Creating an aerosolized formulation of insulin	ARADIGM CORP	27/Oct/1995	Devices, packaging and methodology for efficiently and repeatably creating aerosolized bursts of an insulin containing formulation are disclosed. Devices are hand-held, self-contained units which are automatically actuated at the same release point in a patients inspiratory flow cycle. The release point is automatically determined either mechanically or, more preferably calculated by a microprocessor which receives data from a sensor making it possible to determine inspiratory flow rate and inspiratory volume. The device is loaded with a cassette comprised of an outer housing which holds a package of individual disposable collapsible containers of an insulin containing formulation for systemic delivery. Actuation of the device forces insulin formulation through a porous membrane of the container which membrane has pores having a diameter in the range of about 0.25 to 3.0 microns, preferably 0.25 to 1.5 microns. The porous membrane is positioned in alignment with a surface of a channel through which a patient inhales air. The flow profile of air moving through the channel is such that the flow at the surface of the channel is less than the flow rate at the center of the channel. The membrane is designed so that it protrudes outward at all times or made flexible so that when an insulin formulation is forced against and through the membrane the flexible membrane protrudes outward beyond the flow boundary layer of the channel into faster moving air. Because the membrane protrudes into the faster moving air of the channel the particles of aerosol formed are less likely to collide allowing for the formation of a burst of fine aerosol mist with uniform particle size.

US5970973	Method of delivering insulin lispro	ARADIGM CORP	29/Apr/1998	The need for the delivery of insulin by injection can be reduced or eliminated by a method whereby an aerosolized insulin formulation is delivered to a patients lungs and the rate at which the insulin is absorbed into the blood is increased by the use of monomeric insulin and/or an inhale-exhale breathing maneuver. Particles of insulin and in particular monomeric insulin delivered to the surface of lung tissue will be absorbed into the circulatory system. The rate of absorption is enhanced by the monomeric form of insulin and by instructing the patient to inhale maximally and thereafter exhale maximally. This maneuver causes a spike in the rate at which insulin enters the circulatory system thereby increasing the rate at which glucose is removed from the circulatory system. The insulin or insulin analog may be a dry powder but is preferably in a liquid formulation delivered to the patient from a hand-held, self-contained device which automatically releases an aerosolized burst of formulation. The device includes a sensor which is preferably electronic which measures inspiratory flow and volume which measurement can be used to control the point of drug release. The sensor can also assist the patient in the inhale-exhale maneuver.
US5997501	Intradermal drug delivery device	ELAN CORP PLC	19/Aug/1996	PCT No. PCT/IE94/00055 Sec. 371 Date Aug. 19, 1996 Sec. 102(e) Date Aug. 19, 1996 PCT Filed Nov. 17, 1994 PCT Pub. No. WO95/13838 PCT Pub. Date May 26, 1995An intradermal drug delivery device comprises a housing (301a, 301b) having a drug reservoir (312) therewithin and a gas generation chamber (313) separated from the reservoir (312) by a displaceable membrane (311). A microprocessor-controlled electrolytic cell (316a, 316b, 319) provides gas to expand the gas generation chamber (313) and thereby contract the reservoir (312). A hollow needle (310), communicating at an inner end thereof with the reservoir (312), extends from a lower surface (308) of the housing (301) such that contraction of the reservoir (312) forces drug to escape therefrom via the needle (310). The device permits delivery of drugs of relatively large molecular weights at slow controllable rates. A displaceable protective cover (303) is mounted in means (307) allowing movement of the cover (303) between extended and retracted positions (305, 306). The cover (303) has an adhesive lower surface (309) for attachment to the skin of a subject. In use, a release liner is removed, the device is pressed against the skin and the cover (303) snaps back to the retracted position (306), the needle (310) thereby piercing the skin. After use the housing (301) is pulled away and the cover (303) snaps to the extended position (306) before detaching from the skin, thus concealing the needle (310) before disposal.

US6001069	Ultrasound catheter for providing a therapeutic effect to a vessel of a body	EKOS CORP	01/May/1998	A catheter for use in a vessel of a body is disclosed. The catheter includes an elongated body and a plurality of ultrasound elements coupled to the elongated body. Each of the plurality of ultrasound elements is separated from an adjacent ultrasound element.
US6098620	Device for aerosolizing narcotics	ARADIGM CORP	27/Oct/1995	Devices, packaging and methodology for efficiently and repeatably creating aerosolized bursts of an analgesic (e.g., narcotic) containing formulation are disclosed. Devices are hand-held, self-contained units which are automatically actuated at the same release point in a patients inspiratory flow cycle. The release point is automatically determined either mechanically or, more preferably calculated by a microprocessor which receives data from a sensor making it possible to determine inspiratory flow rate and inspiratory volume. The device is loaded with a cassette comprised of an outer housing which holds a package of individual disposable collapsible containers of an analgesic containing formulation for systemic delivery. Actuation of the device forces analgesic formulation through a porous membrane of the container which membrane has pores having a diameter in the range of about 0.25 to 3.0 microns, preferably 0.25 to 1.5 microns. The porous membrane is positioned in alignment with a surface of a channel through which a patient inhales air. The flow profile of air moving through the channel is such that the flow at the surface of the channel is less than the flow rate at the center of the channel.
US6176842	Ultrasound assembly for use with light activated drugs	EKOS CORP	21/Sep/1998	A kit and method for causing tissue death within a tissue site is disclosed. The kit includes a media with a light activated drug activatable upon exposure to a particular level of ultrasound energy. The kit also includes a catheter with a lumen coupled with a media delivery port through which the light activated drug can be locally delivered to the tissue site. The ultrasound transducer is configured to transmit the level of ultrasound energy which activates the light activated drug with sufficient power that the ultrasound energy can penetrate the tissue site.
US6427681	Method of use of monomeric insulin as a means for improving the reproducibility of inhaled insulin	ARADIGM CORP	21/Jun/2001	The need for the delivery of insulin by injection can be reduced or eliminated by delivering an aerosolized monomeric insulin formulation. Repeatability of dosing and more particularly the repeatability of the blood concentration versus time profile is improved relative to regular insulin. The blood concentration versus time profile is substantially unaffected by specific aspects of the patients breathing maneuver at delivery. Further, the rate at which blood glucose is lowered is increased by the use of monomeric insulin. Particles of insulin and in particular monomeric insulin delivered to the surface of lung tissue will be absorbed into the circulatory system. The monomeric insulin may

				be a dry powder but is preferably in a liquid formulation delivered to the patient from a hand-held, self-contained device which automatically releases an aerosolized burst of formulation. The device includes a sensor which is preferably electronic which measures inspiratory flow and volume which measurement can be used to control the point of drug release.
US6723063	Sheath for use with an ultrasound element	EKOS CORP	29/Jun/1998	A system for delivering ultrasound energy to a treatment section in a vessel is disclosed. The system includes a sheath with a utility lumen and an energy delivery section at least partially constructed from a material which transmits ultrasound energy. The system also includes a drug delivery member having a plurality of drug delivery ports which are positioned adjacent the energy delivery section. The system further includes an elongated body including at least one ultrasound element and configured to be movably positioned within the utility lumen to transmit the ultrasound energy from the ultrasound element through the energy delivery section.
US6979293	Blood flow reestablishment determination	EKOS CORP	16/Dec/2002	A method for monitoring a clot dissolution treatment in a patients vasculature comprises positioning a catheter at a treatment site in the patients vasculature. The method further comprises performing a clot dissolution treatment at the treatment site. The clot dissolution treatment comprises delivering ultrasonic energy and a therapeutic compound from the catheter to the treatment site such that a clot located at the treatment site at least partially dissolves. The method further comprises delivering a thermal measurement signal from a first portion of the catheter to the treatment site during the clot dissolution treatment. The method further comprises receiving the thermal measurement signal at a second portion of the catheter. The method further comprises comparing the delivered thermal measurement signal with the received thermal measurement signal to evaluate a blood flow rate at the treatment site.
US7010340	Methods, systems, and associated implantable devices for dynamic monitoring of physiological and biological properties of tumors	SICEL TECHNOLOGIES INC	15/Feb/2002	Methods of monitoring and evaluating the status of a tumor undergoing treatment includes monitoring in vivo at least one physiological parameter associated with a tumor in a subject undergoing treatment, transmitting data from an in situ located sensor to a receiver external of the subject, analyzing the transmitted data, repeating the monitoring and transmitting steps at sequential points in time and evaluating a treatment strategy. The method provides dynamic tracking of the monitored parameters over time. The method can also include identifying in a substantially real time manner when conditions are favorable for treatment and when conditions are unfavorable for treatment and can verify or quantify how much of a known drug dose or radiation dose was actually received at the tumor. The method can include

				remote transmission from a non-clinical site to allow oversight of the tumors condition even during non-active treatment periods (in between active treatments). The disclosure also includes monitoring systems with in situ in vivo biocompatible sensors and telemetry based operations and related computer program products.
US7311503	Micromachined fluidic device and method for making same	DEBIOTECH SA	26/Sep/2005	The fluid-flow device (100) of the invention comprises a stack (30) covered by a closure wafer (20), said stack (30) comprising a support wafer (36), a layer of insulating material (34), and a silicon layer (32). The closure wafer (20) and/or said silicon layer (32) are machined so as to define a cavity (38) between said closure wafer (20) and said silicon layer (32), said support wafer (36) has at least one duct (102) passing right through it, said layer of insulating material (34) presenting at least one zone (35) that is entirely free of material placed at least in line with said duct (102) so as to co-operate with said cavity (38) to define a moving member (40) in said silicon layer (32), the moving member being suitable under the pressure of liquid in said cavity (38) for reversibly moving towards said support wafer (36) until contact is made between said moving member (40) and said support wafer (36).
US7524304	Drug infusion device	STEADYMED LTD	29/Jul/2005	The invention provides a drug delivery infusion device comprising an injection means (18) in fluid connection with a drug reservoir chamber (12) and pressure-generation means (10) coupled to both the drug reservoir (12) and to a liquid-filled control chamber (13), wherein the coupling is such that the liquid-filled control chamber (13) serves to constrain the motion of the pressure-generation means (10), thereby controlling the drug infusion rate, wherein the liquid-filled control chamber (13) is associated with means for controlled depletion of the liquid therein whereby depletion of the volume of liquid in the control chamber enables the pressure-generation means to drive the drug in the reservoir chamber therefrom for infusion thereof.
US7632228	Membrane for use with implantable devices	DEXCOM INC	29/Jan/2004	The present invention provides a biointerface membrane for use with an implantable device that interferes with the formation of a barrier cell layer including; a first domain distal to the implantable device wherein the first domain supports tissue attachment and interferes with barrier cell layer formation and a second domain proximal to the implantable device wherein the second domain is resistant to cellular attachment and is impermeable to cells. In addition, the present invention provides sensors including the biointerface membrane, implantable devices including these sensors or biointerface membranes, and methods of monitoring glucose levels in a host utilizing the analyte detection implantable device of the

				invention. Other implantable devices which include the biointerface membrane of the present invention, such as devices for cell transplantation, drug delivery devices, and electrical signal delivery or measuring devices are also provided.
US7803148	Flow-induced delivery from a drug mass	NEUROSYSTEC CORP	07/Jun/2007	Drug solutions (or other combinations of vehicle with entrained drug) are prepared by removing drug from one or more masses of a solid form of the drug. The solid form of the drug may be sparingly soluble or insoluble in water. Examples of devices for holding solid drug and facilitating delivery of such drug to targeted regions are also described.
US7918843	Controllable drug delivery device	STEADYMED LTD	22/Oct/2009	A controllable drug delivery device for delivering a liquid injectable drug, the device comprising a drug reservoir (22), a drug administration device (28), a displacement-generating battery (20), and a current-depletion circuit (85), wherein displacement generated by the battery as current is depleted from the battery by the current depletion circuit displaces a wall of the drug reservoir thereby causing the reservoir to expel liquid injectable drug contained therein via the drug administration device, and wherein the drug delivery device further includes a controller (78) that is responsive to a measured parameter indicative of displacement generated by the battery for applying a variable load (80) across the battery in order to provide a substantially constant-current depletion of the battery and thereby cause the drug delivery device to deliver a substantially constant drug delivery rate.
US7935104	Systems and methods for sustained medical infusion and devices related thereto	MEDINGO LTD	03/Apr/2006	Embodiments of the invention are directed to systems, methods and devices for sustained medical infusion with controlled rate injection of a fluid into a body. Such a system may include a first separate reusable unit, a second separate depletable unit a third separate disposable unit having a cannula, and may include a fourth separate remote control unit. Emission of appropriate instructions from the fourth unit, when the first unit, the second unit, and the third unit are coupled together in associative operation and disposed on the skin, power is supplied to an engine for generating motion to a fluid transfer system, and when the cannula is inserted in the body, fluid is transferred from the reservoir to the body, via the tube and the cannula.

US7966054	Disposable single-use external dosimeters for detecting radiation in fluoroscopy and other medical procedures/therapies	SICEL TECHNOLOGIES INC	10/Jun/2004	Methods, systems, devices, and computer program products include positioning single-use radiation sensor patches that have adhesive onto the skin of a patient to evaluate the radiation dose delivered during a medical procedure or treatment session. The sensor patches are configured to be relatively unobtrusive and operate during radiation without the use of externally extending power cords or lead wires.
US7976492	Integrated delivery device for continuous glucose sensor	DEXCOM INC	06/Aug/2009	Systems and methods for integrating a continuous glucose sensor, including a receiver, a medicament delivery device, and optionally a single point glucose monitor are provided. Manual integrations provide for a physical association between the devices wherein a user (for example, patient or doctor) manually selects the amount, type, and/or time of delivery. Semi-automated integration of the devices includes integrations wherein an operable connection between the integrated components aids the user (for example, patient or doctor) in selecting, inputting, calculating, or validating the amount, type, or time of medicament delivery of glucose values, for example, by transmitting data to another component and thereby reducing the amount of user input required. Automated integration between the devices includes integrations wherein an operable connection between the integrated components provides for full control of the system without required user interaction.
US8328082	Medication container encoding, verification, and identification	CRISI MEDICAL SYSTEMS INC	31/May/2011	A medication container encoding, verification and identification method is provided that includes receiving data characterizing a medication, generating an identifier encapsulating the data and applying an identifier to a medication container such that it is automatically readable by a medication administration device and/or a medication wasting device. Related apparatus, systems, methods and articles are also described.
WO2007126851	DEVICES, SYSTEMS AND METHODS FOR MEDICAMENT DELIVERY	INTELLIJECT INC	28/Mar/2007	An apparatus includes a housing, a medicament container and an actuator. The apparatus includes a label configured to be coupled to a medicament delivery device. The label includes a first surface and a second surface. The first surface is configured to be coupled to an outer surface of the medicament delivery device. The second surface includes a textual indicia. The label further includes an electronic circuit system configured to output an electronic signal.
WO2009053919	MEDICAL INJECTION DEVICE WITH MICRONEEDLES	DEBIOTECH SA	23/Oct/2008	The present invention relates to a medical injection device for delivering medium to a patient comprising at least two microneedles, wherein microneedle tips are arranged with a distance.

WO2009136336	MEDICAL MICROBUBBLE GENERATION	ARTENGA INC	03/May/2009	Medical apparatus and processes controllably generate medically useful micro or nano bubbles of medically desirable and controllably selectable size, size distribution, homogeneity and concentration (and/or other key bubble parameters) for patient infusion, and/or which may incorporate therapeutic or other agents for patient infusion and/or may be combined with therapeutic or other agents prior to infusion into patients. The bubble generation apparatus and processes controllably permit the adjustment and selection of key bubble parameters through bubble generation actuation and orientation techniques and through selection of bubble fluid compositions in order to facilitate medical research and/or to optimize treatment for imaging, therapy, sonoporation, inertial and non-inertial cavitation, and acoustic activation, among other medical uses. Disposable cartridges containing such bubbles are provided and may include means for patient infusion.
WO2010020891	PASSIVE FLUID FLOW REGULATOR	DEBIOTECH SA	26/Jun/2009	A fluid flow regulator (1) of the passive type is disclosed which has a fluid inlet adapted to be connected to a fluid reservoir and a fluid outlet (13)adapted to be connected to a patients body. The regulator comprises a rigid substrate (2) and a resilient membrane (3) tightly linked together so as to define a cavity (6) there between which is disconnected to the fluid outlet while the membrane has a first surface (12) opposite the cavity which is connected to the fluid inlet. The membrane has a plurality of through holes (15) contiguous with the cavity,to define a pathway for a fluid from the fluid inlet to the fluid outlet, and is flexible so as to be able to come into contact with the substrate as a fluid applies a sufficient pressure on the first surface. The through holes are arranged such that,when the fluid pressure increases, they close one after the other to increase the regulator fluidic resistance so that a fluid flow rate would be substantially constant as a function of the pressure applied on the first surface within a predefined pressure range.
WO2010023666	DEVICE AND METHOD FOR ENHANCED SUBCUTANEOUS INSULIN ABSORPTION	MEDINGO LTD	27/Aug/2009	Products and methods directed to the improved infusion of fluids are disclosed. Such products and methods can be used to more efficiently and efficaciously administer therapeutic pharmaceuticals to a subject in need of treatment. In many instances, the systems comprise a therapeutic fluid delivery system and a mechanism for enhancing the absorption of the therapeutic fluid.. The enhancement of the absorption of the therapeutic fluid is generally performed locally i.e., at or near the site of administration of the therapeutic fluid. The system and methods can be used to deliver any number of therapeutic fluids including but not limited to insulin.

WO2010121103	SYSTEM AND METHOD FOR CONFIGURING A RULE SET FOR MEDICAL EVENT MANAGEMENT AND RESPONSES	HOSPIRA INC	16/Apr/2010	A system and method to configure a rule set used in connection with a medical monitoring system for monitoring patients and patient care equipment, especially medication delivery pumps, based on a variety of conditions and parameters associated with monitored biometric information and equipment information and for providing user-defined responses to those conditions and parameters.
WO2011028997	ADHESIVE SKIN PATCH WITH PUMP FOR SUBCUTANEOUS DRUG DELIVERY	MINIPUMPS LLC,TAI YU-CHONG	03/Sep/2010	A drug- delivery device (100) includes a skin patch (102) with an integral delivery vehicle (106) adherable to a patients skin. An exterior surface of the patch defines an envelope within which is disposed a programmable drug pump (114) including a reservoir (110), a cannula (112) for conducting liquid from the reservoir to the delivery vehicle, and a mechanism for forcing liquid from the reservoir through the cannula and into the delivery vehicle.
WO2012032337	A TRANSDERMAL DRUG ADMINISTRATION DEVICE	OREXO AB	05/Sep/2011	A transdermal drug administration device comprising a drug delivery element (10) defining a contact surface (12) for location, in use, against a patients skin. The drug delivery element (10) includes a sustained-release pharmaceutical composition. The composition comprises a network of a carrier material having a high mechanical strength and an active pharmaceutical ingredient. The active pharmaceutical ingredient is co-formedly interspersed within pores in the solid, continuous network of the carrier material.
WO2012061556	WEARABLE DRUG DELIVERY DEVICE HAVING SPRING DRIVE AND SLIDING ACTUATION MECHANISM	FLUGEN INC	03/Nov/2011	A drug delivery device is provided. The drug delivery device includes a drug reservoir in fluid communication with a microneedle array. The drug delivery device has a sliding actuation mechanism that may be activated by a button or lever. Actuation of the drug delivery device inserts the microneedle array into the skin of a subject and causes a piston to compress the drug reservoir, thereby delivering the drug through the microneedle array to the subject.
WO2012125695	INSTRUMENT AND METHODS FOR FILLING AN IMPLANTED DRUG PUMP	MINIPUMPS LLC,TAI YU-CHONG	14/Mar/2012	A tool for refilling an implantable pump (100) having at least one reservoir (104). The tool includes a plurality of independent fluid channels (212, 214, 216); a fluid reservoir in fluid communication with a first one of the fluid channels; at least one pump fluidly coupled to the fluid channels, the at least one pump and the independent fluid channels differing from each other in number, wherein (i) a pump is configured to apply positive pressure to the first fluid channel so as to drive fluid from the fluid reservoir therethrough, and (ii) a pump is configured to apply negative pressure to the second fluid channel; and a connector (210) for removably connecting the fluid channels to the at least one reservoir.

Summary

Development in microfabrication (micromachining, microelectromechanical systems, MEMS) permits the integration of hard and soft structures, and enables the design of controllable microfluidic systems, which is applied to drug delivery. MEMS based microneedles have been used to deliver a broad range of different low molecular weight drugs, biotherapeutics and vaccines, including published human studies with a number of small-molecule and protein drugs and vaccines. Similarly Micropumps are also extensively used.

This report graphically analyzes Miniature Drug Delivery technologies from various perspectives, categorizes and highlights the key and upcoming companies involved.

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