

Pens, autoinjectors and patch injectors

Self-injection market, the platform approach and trends

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Ypsomed: Developer and Manufacturer of Self-Injection Devices

- **Ypsomed** is the **world leading medical technology company** in the field of **self-injection solutions** and products for the treatment of diabetes
- Ypsomed has over **30 years of experience** in the development and manufacture of injection devices, infusion systems and pen needles
- Ypsomed is headquartered in Burgdorf, Switzerland, and employs approx. **1,400 people** at various sites in Switzerland and within its European sales and distribution network which includes **14 subsidiaries**
- Sales in the 2016/17 financial year:
CHF 466.6 million
- **Vision:** Ypsomed solutions make self-care simpler and easier



Main presentation topics

- Introduction to self-injection devices
- Current injection device market
- Save time-to-market with custom products
- Outlook / future trends



Devices for self-injection

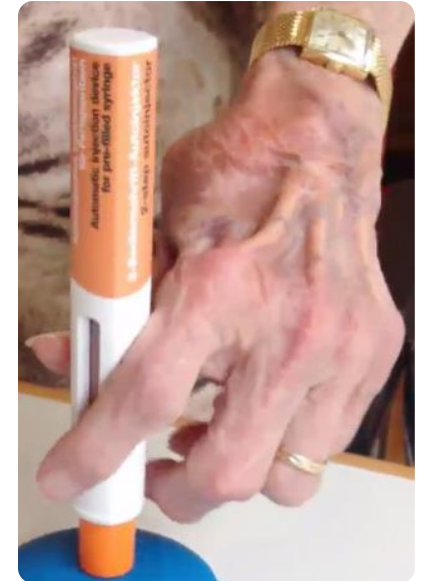
Syringe and vial



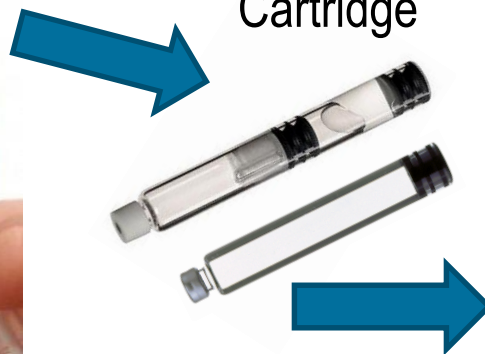
Pre-filled syringe



Autoinjector



Cartridge



Pen Injector



Patch Injector



Multidose pen injector

- Liquid stable drug generally with preservative
- Injection frequency: From 5x daily to daily to 1x weekly
- Variable dosing from 10 – 600µl (800µl)
- 3 ml cartridge
- Good readability of dose display
- Intuitive dose setting and correction
- Reusable or disposable pen



Multidose pen for fixed or selected doses

- Variable or fixed dosing from 10 – 300µl
- 1x daily to once weekly
- Dosing stop at max. dose, e.g.
 - Exenatide: 20, 40µl,
 - Liraglutide: 100, 200, 300µl
 - Teriparatide: 80µl
- 3 ml or 1.5ml cartridge
- Twist to dose or pull – push operation

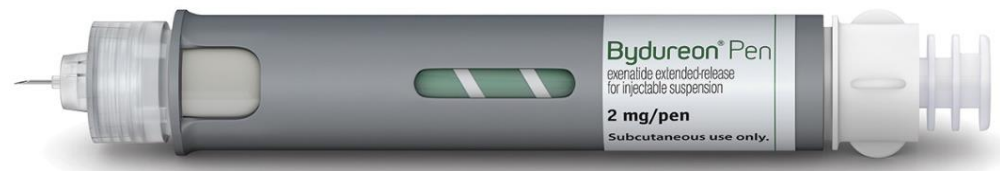


Simple pull – push fixed dosing.



Dual chamber pen injector

- Lyophilised drugs, microspheres or two liquids that need to be mixed prior to injection
- 1x weekly or 1x a month
- Mostly monodose
- Dose fix or variable



Autoinjector / pen for pre-filled syringes

- Fixed dose from 0.2 – 1.0ml (2ml respect.)
1ml long / 2.25ml pre-filled syringe
- Weekly, biweekly or monthly typically
- Integrated needle safety
- Simple to use –
suitable for limited dexterities



Markets / therapeutic areas for self-injection

Other hormones:
hGH, infertility,
osteoporosis

MABS:
Autoimmune diseases,
MS, RA, psoriasis, IBD,
asthma, cancer, hep C

Diabetes hormones:
Insulins, GLP-1s

Emergency drugs:
Anaphylactic shock,
migraine, military



Market development of self-injection devices

1980s

Launch of first reusable pens



Novopen (Novo)



OptiPen (Hoechst)



KabiPen (Pfizer)

1990s

Launch of first disposable pens



Novolet (Novo)



OptiSet (Sanofi)

2000s

Next generation disposable pens



FlexPen (Novo)



SoloSTAR (Sanofi)



Humira (AbbVie)



Enbrel (Amgen)

2010s

Approx. 13+ disposable pens

Approx. 20+ disposable auto-injectors



FlexTouch (Novo)



Repatha (Amgen)

Market update

Self-injection device potential by indication

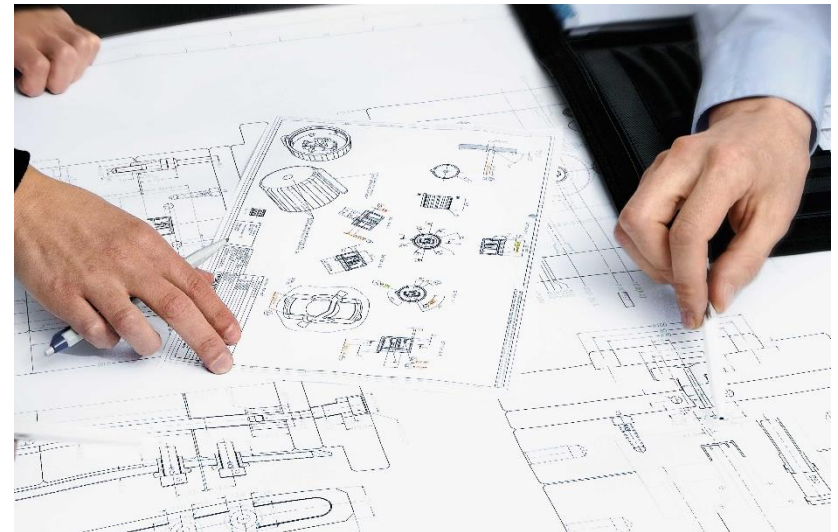
Therapy	No. Patients	Reusable Devices p.a.	Disposable Pens p.a.	Disposable AI p.a.
Diabetes / Insulin	44+ million	9+ million	1.2+ billion	-
Diabetes / GLP-1	3.5+ million	-	50+ million	45+ million
Growth disorders / hGH	0.4 million	0.15 million	8+ million	-
Osteoporosis / PTH	1.5 million	-	6+ million	-
Infertility / FSH	1.5 million ¹⁾	0.35 million	5+ million	-
Autoimmune: RA, broad-spectrum, TNF-inh.	4.0 million	-	-	43+ million
Autoimmune: Psoriasis, IBD	0.8 million	-	-	6+ million
Autoimmune: Asthma	0.2 million	-	-	1+ million
Multiple sclerosis / IFN- β & Copaxone	1.8 million	0.25 million	-	7.5 million
Migraine / Sumatriptan, new-CGRP-mAbs	0.3 million	-	-	4+ million
Anaphylactic shock / Epinephrine	5+ million	-	-	10+ million ²⁾

Legende: 1) cycles (times ~13 injections); 2) Auto-injector intramuscular i.m.

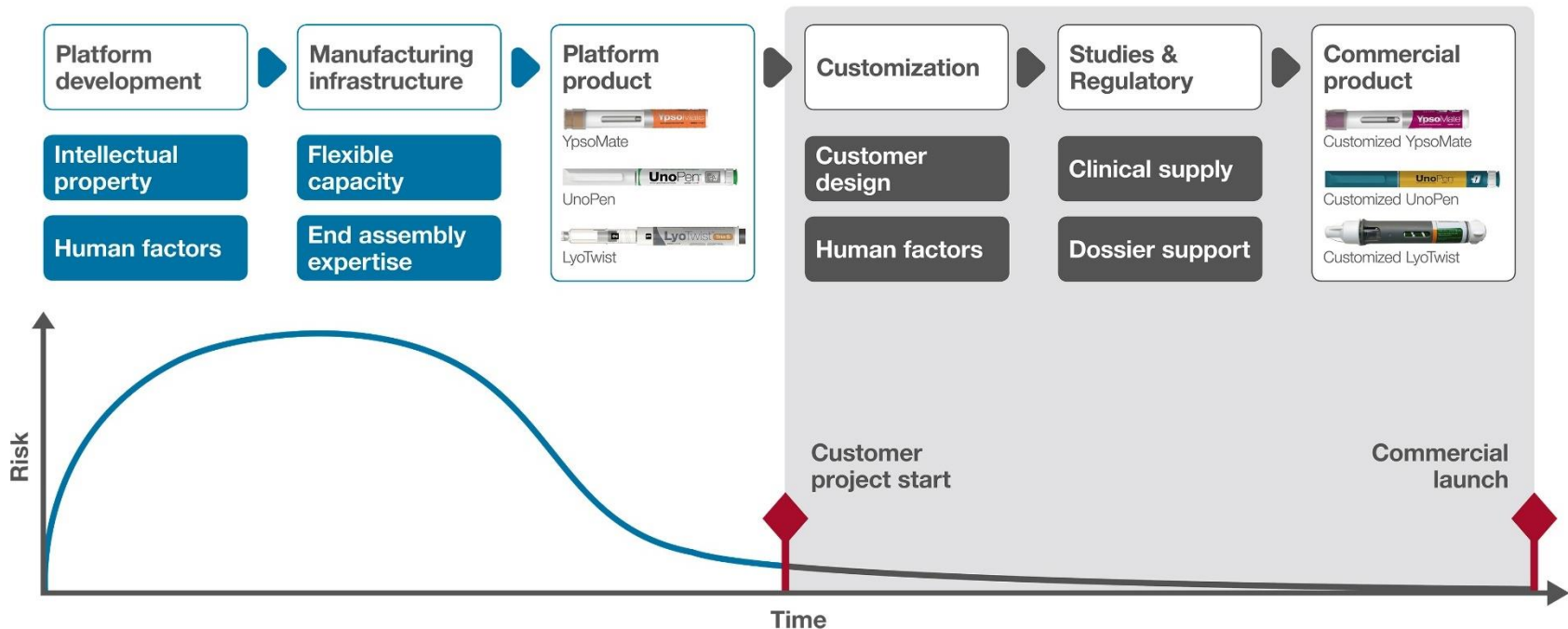
Platforms

How we used to do development...

- Bespoke products for each customer
- Start with some ideas / concepts and do development from scratch
- Long leadtimes and high development and investment costs
- Significant technical and timeline risks
- Small manufacturing scale / high unit cost



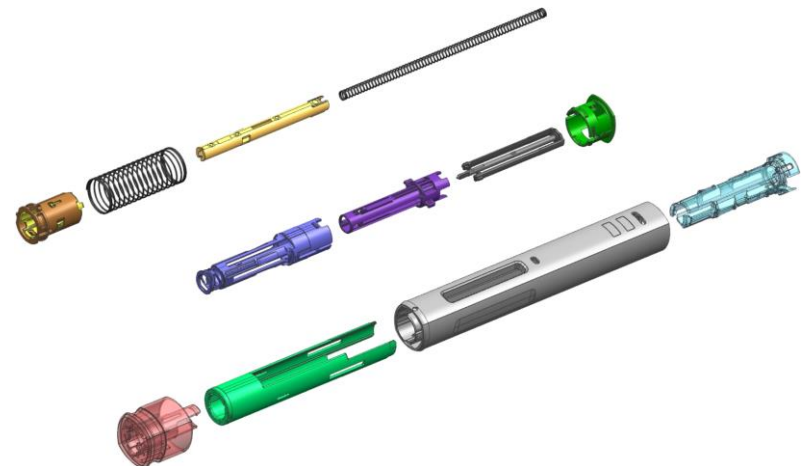
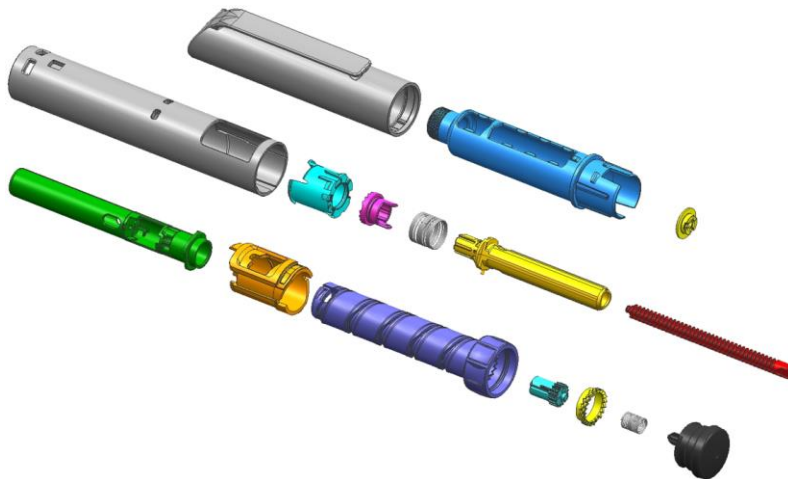
Platform strategy lowers risk and shortens timelines for customers



Development of new **platform** products **decoupled** from **customer** projects.
Risk moved in-house to cover platform development and installation of manufacturing infrastructure.

Manufacturing strategy - clinical

- **Pens and autoinjectors are complex**
- Single cavity moulds are only used during innovation phase
- Typically 2-cavity base moulds only used for customer specific parts
- Fully automated manufacturing infrastructure available for clinical quantities



Manufacturing strategy – commercial

- **Immediate scale-up** from 2-cavity to 8-/16-/32-cavity tools for most industrial-scale components
- **Fully automated assembly** equipment **flexible** to accommodate different versions and customer capacities
- No **scale-up** issues
- **Reliability** of supply



Fully automated manufacturing of UnoPen™ subassemblies

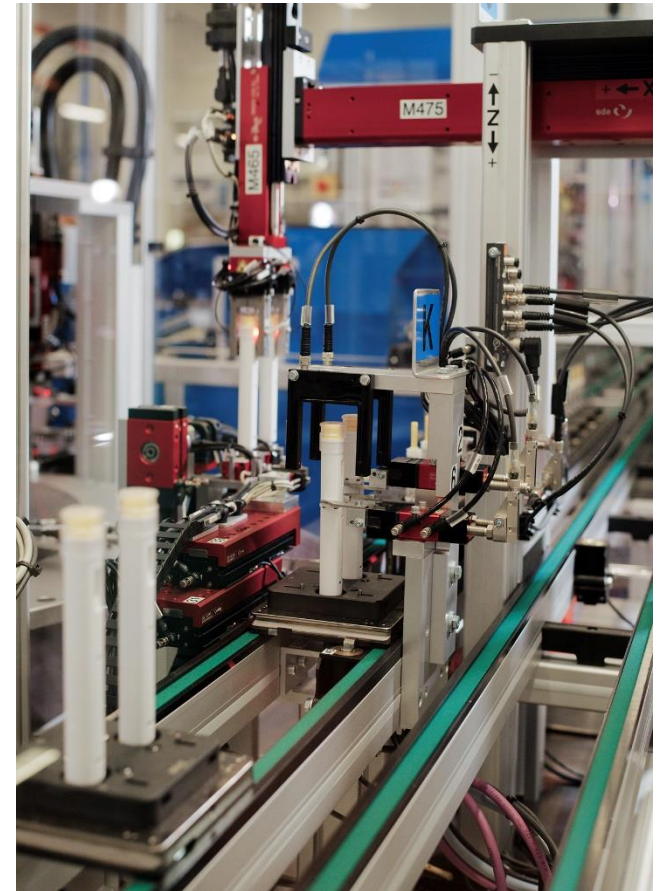
YDS UnoPen™

**UnoPen™ Disposable Pen Injector –
Fully Automated Manufacturing**



Quality control

- Implementing **proper quality control** in fully automated systems is a challenge but leads to a **new level of safety** and confidence
- Automatic **performance control** of assembly stations in real time
- Camera controls
- In-line functional checks
- Seamless **interface with SAP system**, all parts entering the machine are traceable in the finished product



Shared equipment approach

- **Sharing equipment** was reserved to fill & finish CMOs*, but has now reached ODM** companies
- Access to **manufacturing capacity** at only a **fraction of cost**
- No investment in equipment that **may become redundant**
- **Flexible capacity** that perfectly suits changing market demands
- Clear **differentiation** from competitors through **various design options**



* CMO: Contract Manufacturing Organisation e.g. contract fillers

** ODM: Original Device Manufacturer

2.25ml PFS-based autoinjectors are becoming standard

- Demand for **less frequent injections**
e.g every two, three or six months
- ➔ larger doses, thus larger injection volumes required
- Large volume injections are mainly being considered for treating autoimmune disease such as rheumatoid arthritis or psoriasis
- Potential for new drugs for treating Alzheimer and immuno-oncology therapies
- Further improvement in **conventional compression spring** technologies



Wearable injector – «Sweet spot»

- Patch device, single dose, disposable
- Fixed dose up to 5ml (10ml)
- Injection time 5-10 min
- mAbs for autoimmune and immuno-oncology indications
- Prefilled, glass cartridge
- Controlled injection
- Automated needle insertion and safety



West SmartDose
prefilled,
electromechanical,
patient assembled



Ypsomed YpsoDose
prefilled,
preassembled,
electromechanical



BD Microinfusor
Prefilled,
preassembled,
mechanical



Unilife Precision
Prefilled,
preassembled,
mechanical

YpsoDose – Features & benefits

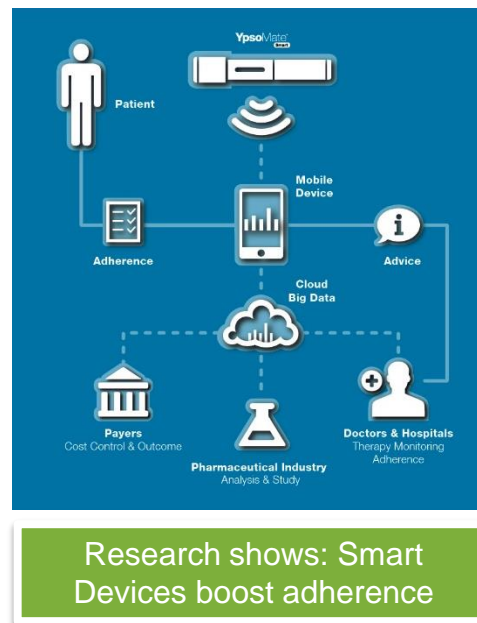
- **Pre-filled and pre-assembled** for easy patient training and use
- **Patch and inject** for simple and ergonomic handling
- **Clear communication** of via visual and audio signals before, during and after injection
- **Standardised cartridge** compatible with existing filling processes → allowing **bulk or tub** filling
- **Unique electromechanical drive** system for a range of fill volumes and viscosities



Smart devices to improve therapy outcomes

Market pull

- Improving patient support and convenience
- Trend toward outcome-based payments
- Need to analyse real-world effectiveness
- Real-time therapy monitoring



- Compact and low-cost processing power and data storage
- Sensor miniaturization and energy efficiency
- Low-cost sensor and battery concepts
- Network benefits of ubiquitous wireless connectivity
- Big data analytics

Technology push

References: Hall et al., 2014; Tran et al., 2014; Linn et al., 2011

Ypsomed's Vision for Smart Devices

From add-ons to full integration

Reusable add-ons «SmartPilot»

- Guide patients and provide real-time feedback
- Ongoing projects for pens and autoinjectors

Connectivity integrated in disposable devices

- New possibilities provided by low-cost sensor and device interfaces
- Technology scouting / early concept development work

SmartPilot for YpsosMate – Connected add-on

Patient
safety

Read **smart NFC label** to relate with drug type, dose strength, expiry date etc.

Tracking

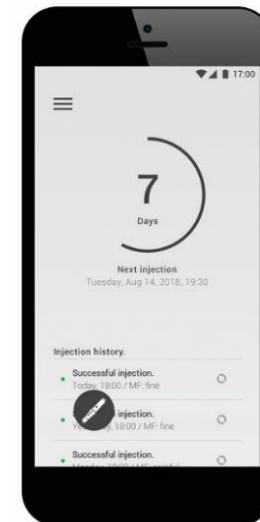
Captures **date / time and result** of injection

Guidance

Support patients real-time and step-by-step through handling sequence

Transform
w/o change

Flexibly transforms 2-step autoinjector into a connected system **without modification**



Outlook summary

Ypsomed Strategic innovation areas



SmartPilot™
Go for smart guidance



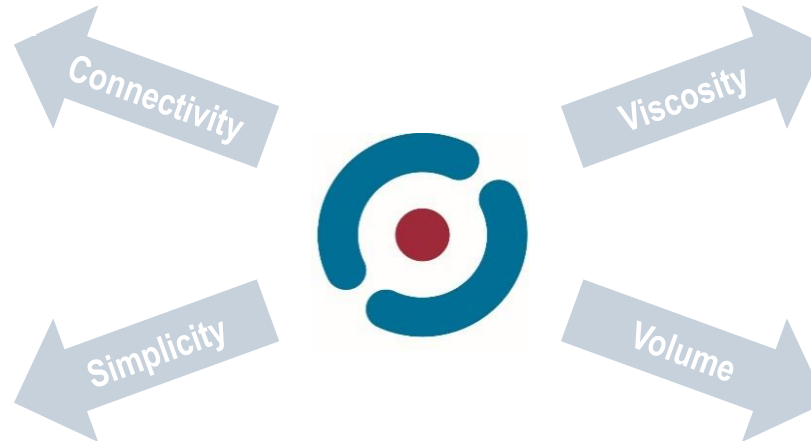
YpsoMate® 2.25 Pro
Go for 2-step



YpsoPump®
Go for ease-of-use



YpsoDose®
Go for pre-filled



Thank you for your attention
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