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Market Perspectives for Photonics Companies in Healthcare

European Photonics Roadshow series - Stockholm

11 June 2018

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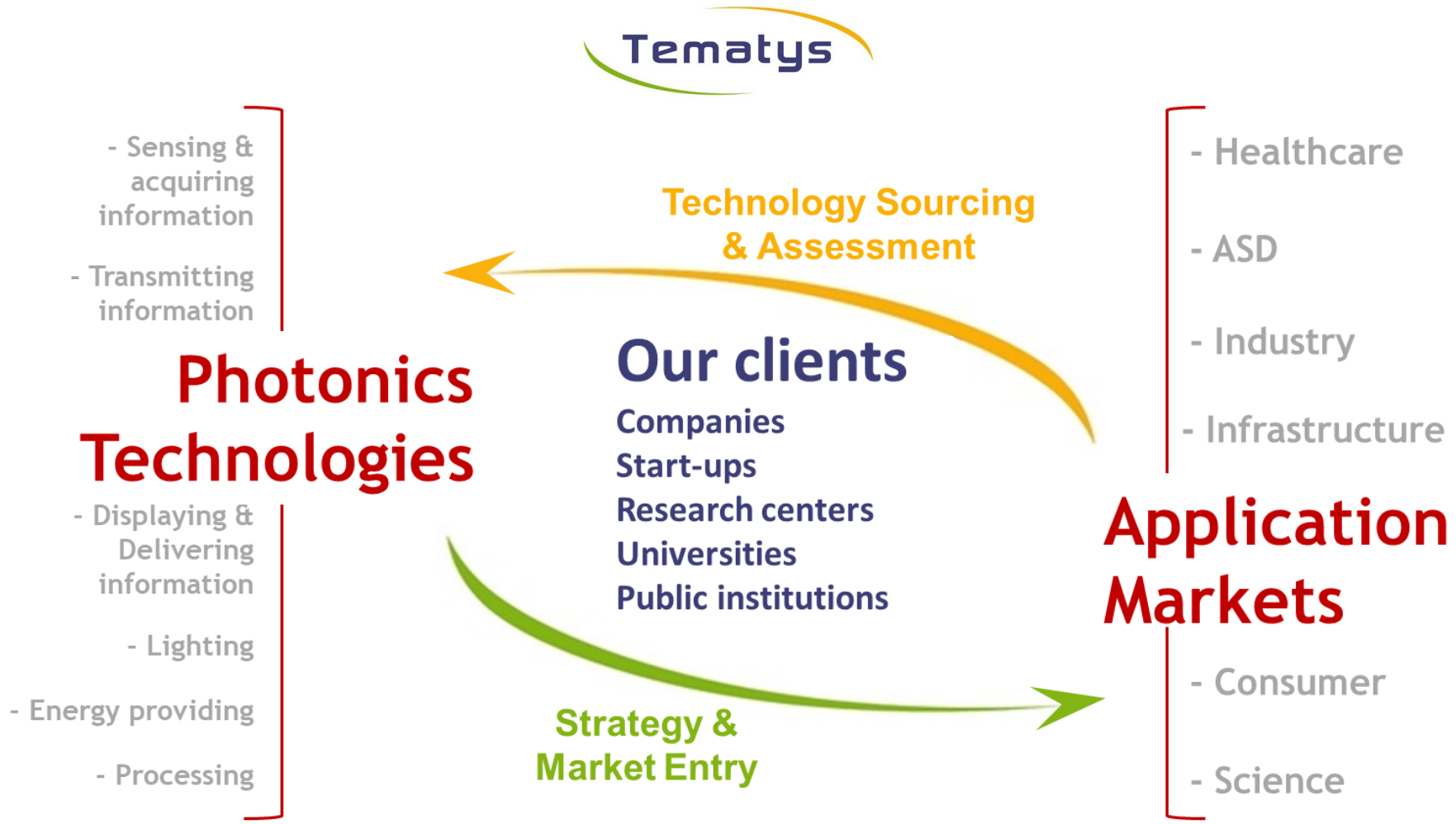
Market research - Technology analysis - Strategy & Decision making

Optics – Photonics – Imaging - Sensors

Activities:

- Pushing optics & photonics technologies into application markets
- Sourcing these technologies for application market integrators



More than 120 customers in 15 Countries

- Market Studies and Reports
- Technology transfer
- Technology scouting & assessment
- Strategy & Business Plan

- Tematys is also a partner for Exploitation and Dissemination activities in H2020 and national Projects
- On-going projects : MIRPHAB, MIRBOSE, C3PO, COMTONIQ

Companies & start-ups

Research centers & Universities

Public institutions & Clusters

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Grey & Green Revolutions

- In the last 20 years, we have faced two simultaneous revolutions: **grey** and **green**.
- The ***grey*** revolution is linked on continuous growth of an aging population as well as economic issues linked to sustainable unbalanced healthcare systems. It modifies the entire perspective from a treatment-oriented system toward a diagnostic-oriented one, the end-point being *companion diagnostics*, which is promising but far away.
- The ***green*** revolution is linked to the increasing risk of epizootic diseases and food-related disorders. It urgently requires solutions for safer and healthier food.

Necessity of New Technologies

- All of these revolutions have in common a strong need to **study the real-time evolution of living organisms, or a part of them** (i.e. tissues, organs, cells, proteins, DNA).
- In terms of business, the technologies permitting adequate response to these challenges will have a bright future.
- BRICs and other emerging countries will have to face the same problems:
  - in the short-term: food safety
  - in the medium-long term: aging population

Million-Unit Markets Targeted

- These revolutions have put **Photonics technologies at the heart of the scientific** agenda. New kinds of reliable sources, detectors, passive components and specialty fibers are now available.
- Biophotonics products are becoming increasingly rugged and cost-effective. Today, the Biophotonics market consists of hundreds or thousands of units/year of high-end desktop devices for Life Sciences and Healthcare applications.
- Photonics technologies could potentially **spread to cost-effective devices targeting million-unit markets** for in situ and Point-of-Care measurements.
- In the last years, industrial leaders in analytical sciences (GE Healthcare, Agilent, Danaher, Thermo, etc.) have targeted Photonics companies.
- More interesting is the involvement of companies like Biomerieux & Sanofi in Photonics buy-outs.

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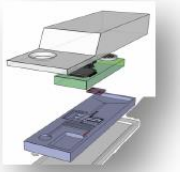
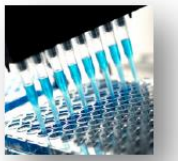
Critical needs of the healthcare sector



- Democratizing consumer diagnostics
  - Accurate clinical data anywhere and anytime

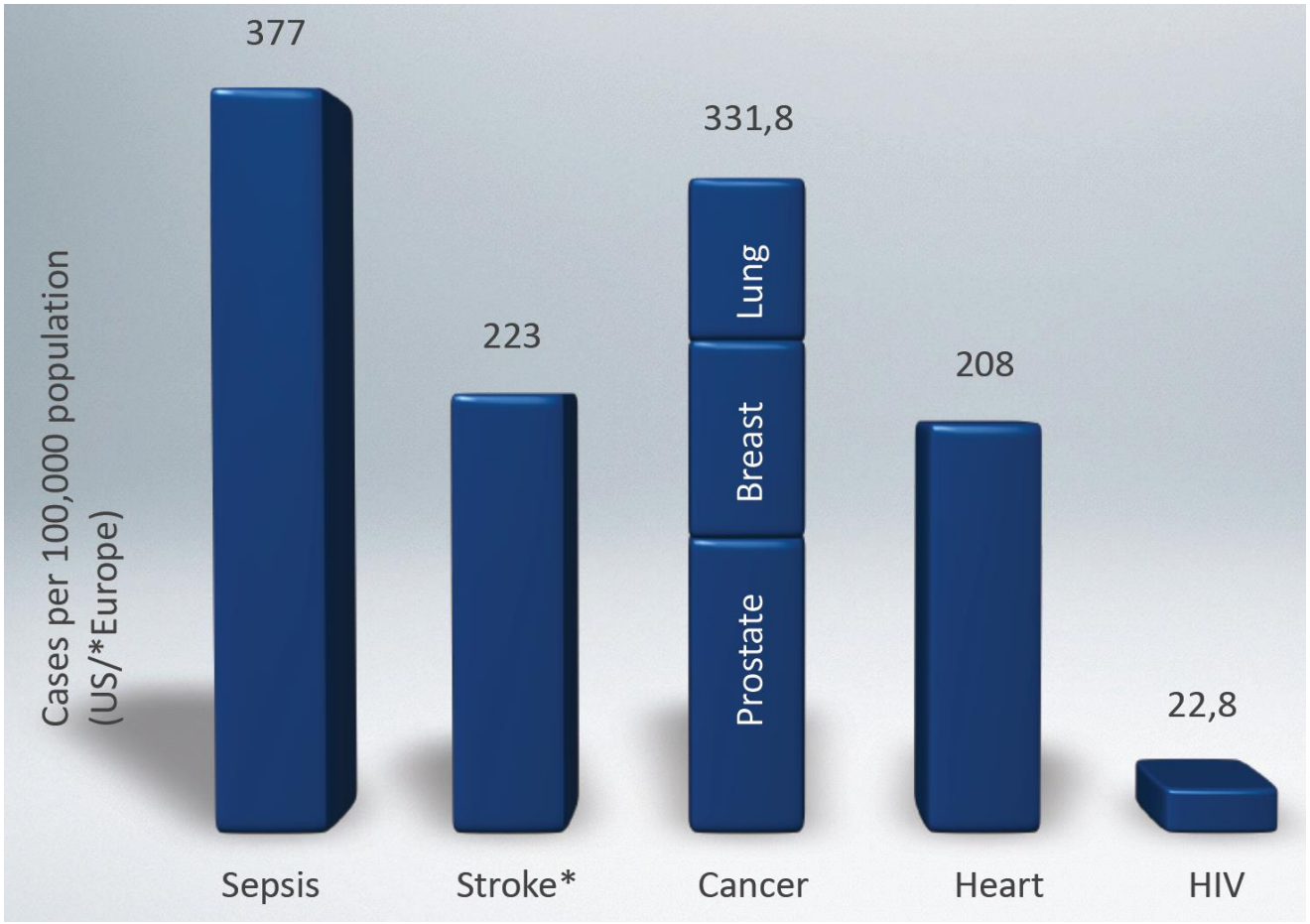
- Powerful tools to detect disease earlier



- Tools to predict drug efficacy, toxicity and side effects with a lower cost and higher data richness
  - Personalized medicine

- Tools to interface with the nervous system

Most Common Diseases



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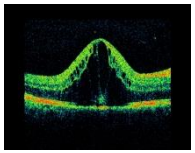
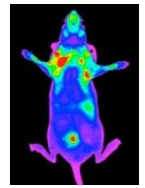
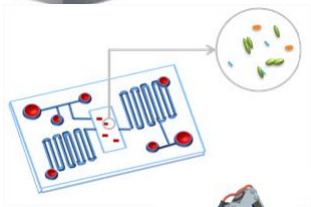
Photonics Technologies for Healthcare

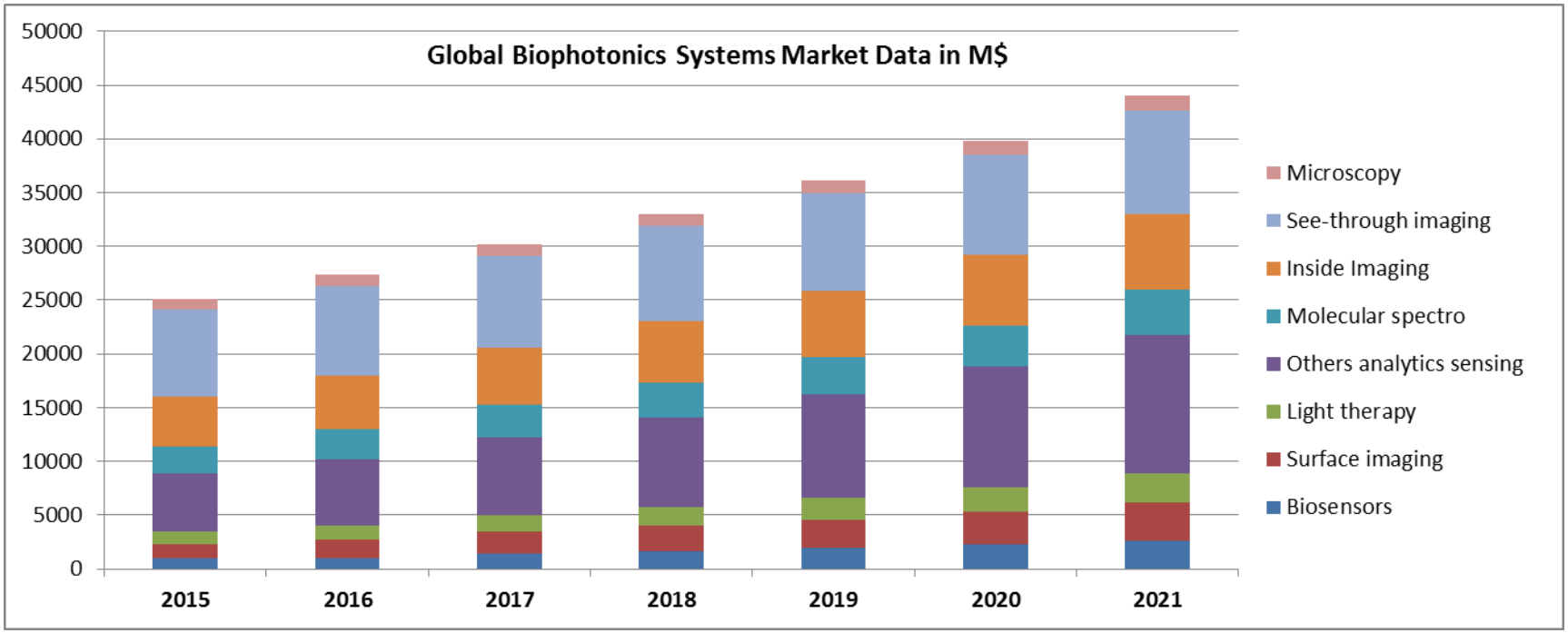
Imaging	In-Vivo	Surface imaging	Slit lamp, Ophthalmoscope, Aberrometer
			OCT for ophthalmology, dermatology
			Photoacoustic imaging for dermatology
		Inside imaging (endoscopy)	Rigid
			Flexible
			Disposable
			Camera Pills
		See-through Imaging	X-ray imaging
			Optical molecular imaging (fluorescence, bioluminescence, etc.)
			Photoacoustic imaging
	In-Vitro	Optical microscopy	Classical
			Confocal
			Non-linear
			Super-Resolution
Analytics, Sensing	In-Vivo	Oximetry	Hospital oxymetry, Home Care oxymetry
	In-Vitro	Sequencing	Sequencing, next-generation sequencing
		Cytometry	Classical cytometry, online cytometry
		Molecular spectroscopy	IR
			UV-VIS
			Raman
			Others (colorimetry, ellipsometry, etc.)
		Biosensors	Label-free
			Labeled
Processing, Curing	Light Therapy	Medical lasers	Surgery lasers
		Others	Decontamination



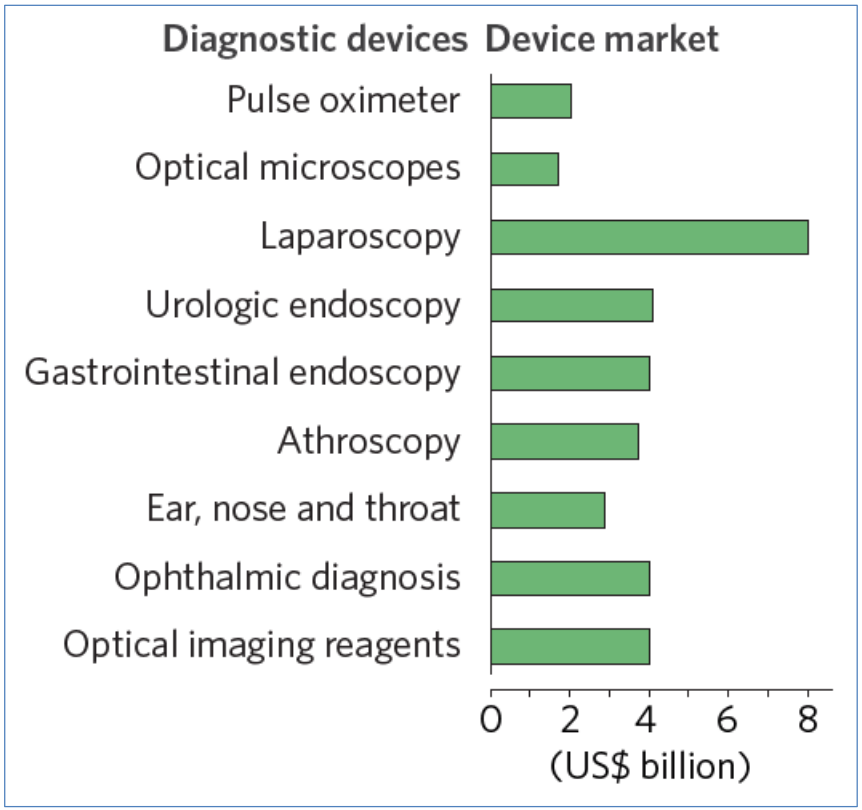


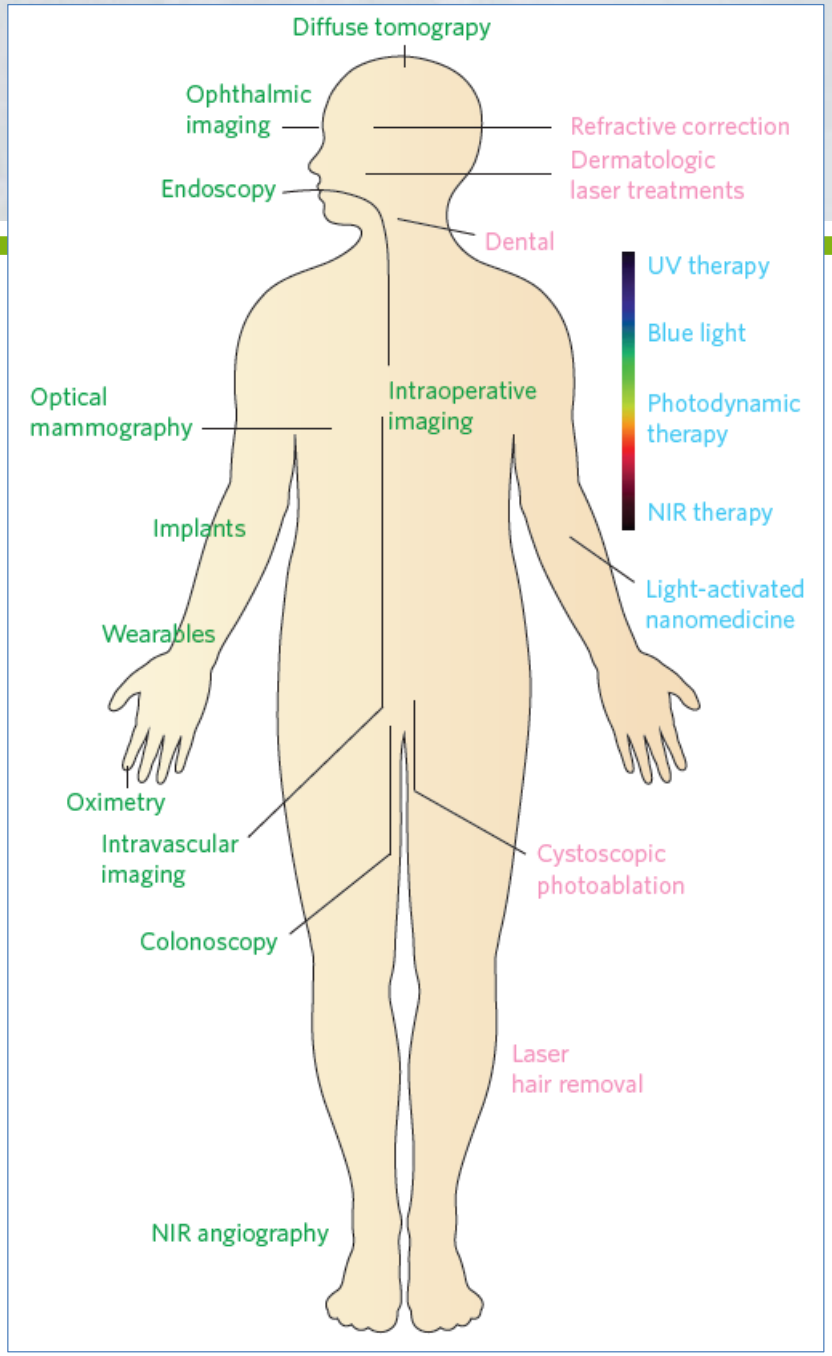

Market of Photonics Systems for Healthcare



- The Market of Photonics systems for Healthcare will exceed $30B in 2018.
- The category "Other analytics sensing" includes the oximetry, sequencing and cytometry markets.

Diagnostic devices



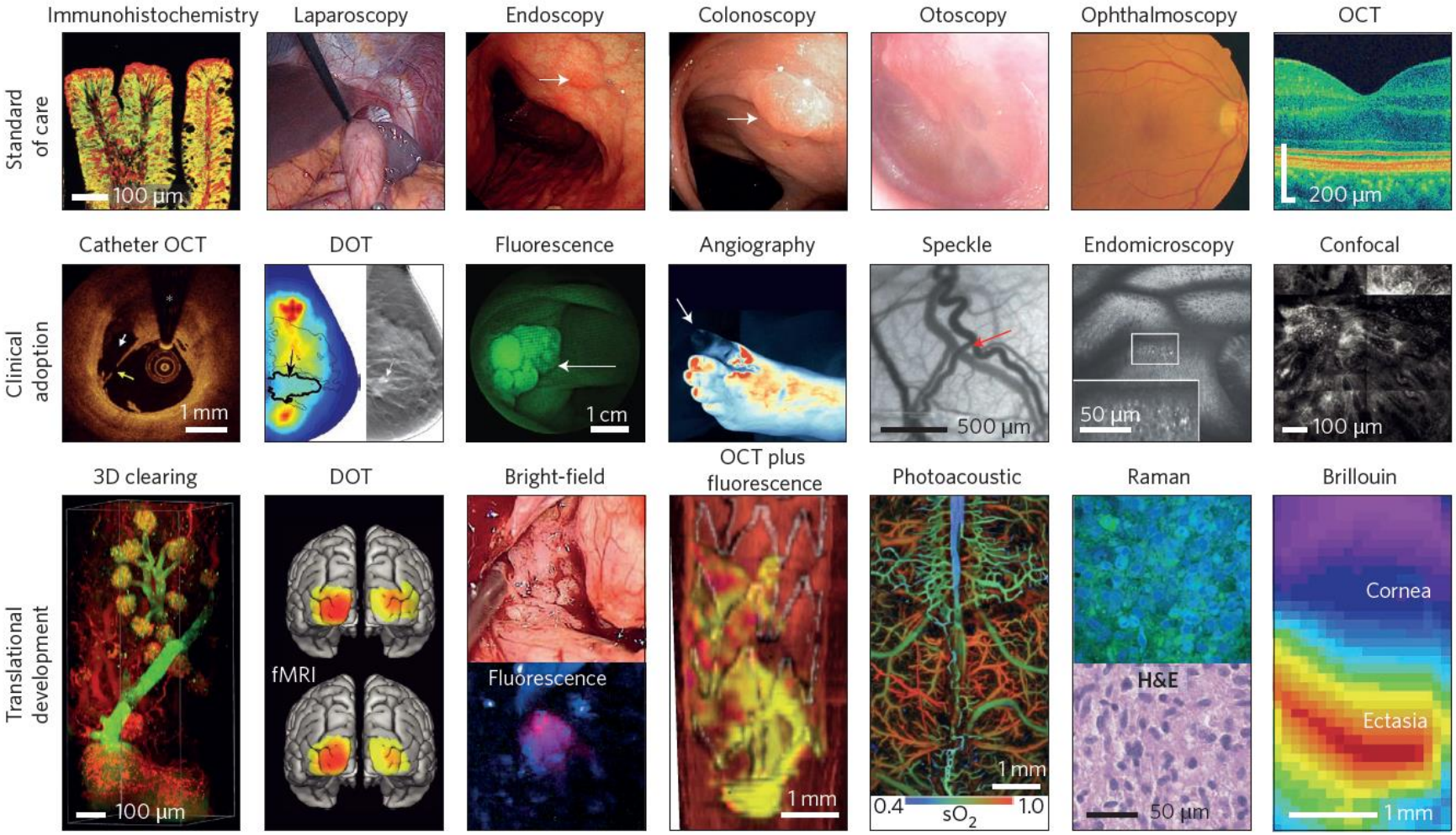


Diagnosis and imaging (green), surgery (pink) and therapy (blue)

Market Trends

- Miniaturization is a major trend in every industry sector, and Healthcare is no exception.
- Until now, healthcare technologies have been bulky, expensive systems installed in hospitals and life science labs (CT scanner, MRI, etc.).
- Today, more compact and affordable systems are available at the doctor's office (Point-Of-Care).
- The next step is small devices available at a patient's home, or anywhere for that matter (glucometer, oxymeter, electro-cardiograms on smartphones, etc.).

Evolution of technologies



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Emerging medical applications of photonics technologies

- Photonics technologies for diagnostic are increasingly less invasive, more accurate, molecular specific, cost effective and mobile.
- More surgical procedures will benefit from advanced imaging and lasers.
- Moreover photonics therapies will integrate nanotechnologies and genetic technologies.

Area	Emerging applications
Diagnostic imaging	Non-invasive screening Molecular diagnosis
Health monitoring	Point-of-care testing Implantable devices Mobile and Home care
Surgery	Robotic surgery Intraoperative optical biopsy Augmented Reality
Therapy	Targeted therapy Personalized medicine Optogenetics

Home Care Applications

- Home Care consists of providing medical services at a patient's home. The objectives are to reduce medical costs and improve the patient's condition by reducing hospitalization time, while providing continuous at-home monitoring.
- Today, Home Care is mainly applied to:
  - Elderly people
  - Post-surgery recovery
  - Chronic disease monitoring
- Home Care technologies can be classified into four groups:

Home Care: An Opportunity for Photonics

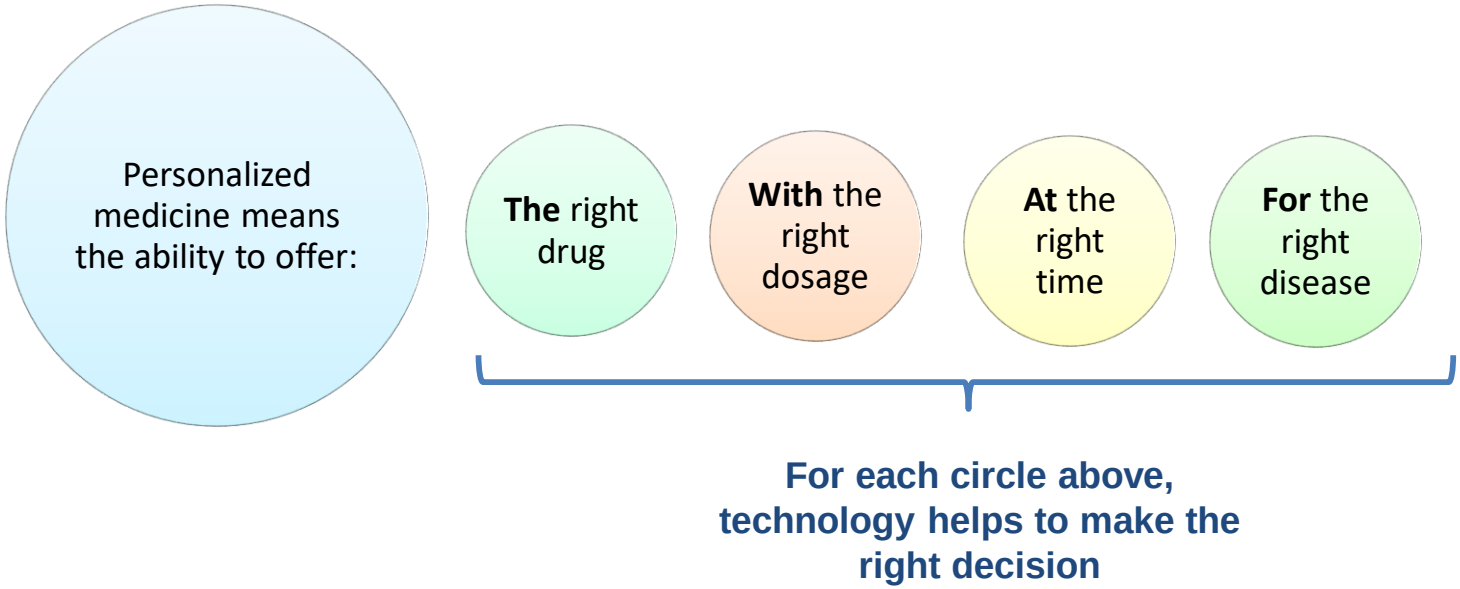
- Providing medical attention at a patient's home requires relatively inexpensive, miniaturized, sensitive diagnostic tests.

- Photonics technologies are well-positioned for Home Care applications. Indeed, these technologies address all of the above requirements.

- Over the next three years, we don't expect to see wide development in the Home Care market. However, an **important growth is forecast for 2020 - 2025.**

Introduction to Personalized Medicine

- Personalized medicine is an **emerging field** that promises radical changes in healthcare.
- Personalized medicine refers to the tailoring of medical treatments to each patients' individual needs and characteristics.

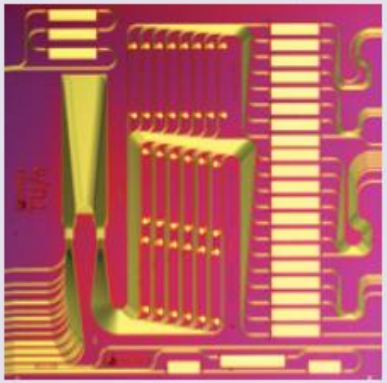


Personalized Medicine An Opportunity for Photonics

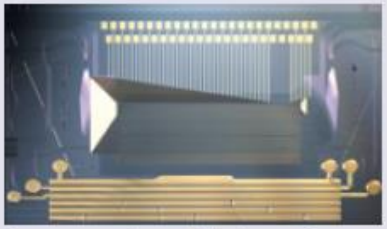
- Personalized diagnostic tests already exist (i.e. Alere-CD4 monitoring) and will spread in the near future
- Nevertheless, the model “one drug for one patient” seems almost impossible at this stage
- Challenges:
  - Pharmaceutical business model needs to change
  - Costs
  - Clinical validation
  - Involve all entities (Health authorities, pharmaceutical companies)
- The advantages of photonics for Personalized medicinal testing are very similar to the ones for Home Care testing.

Emerging technologies : Photonics Integrated Circuits (PIC)

Medical and bio-imaging

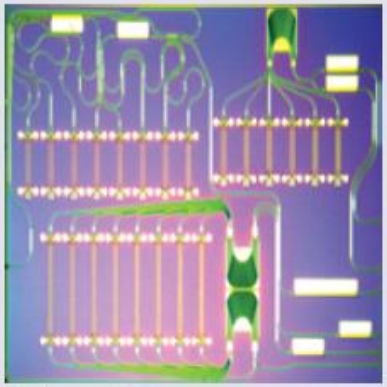


Pulse shaper for bio-imaging

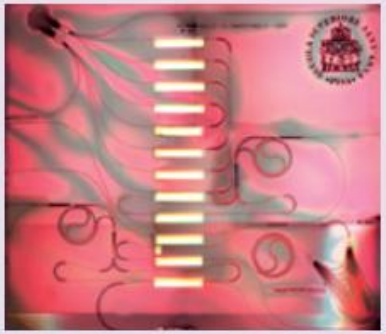


Integrated tunable laser for optical coherence tomography

Optical data handling

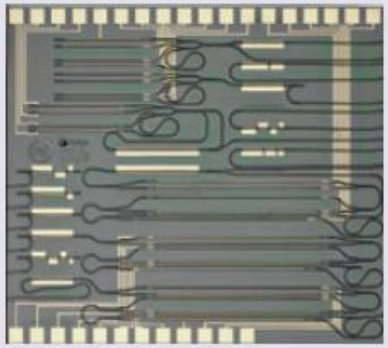


Pulse serialiser

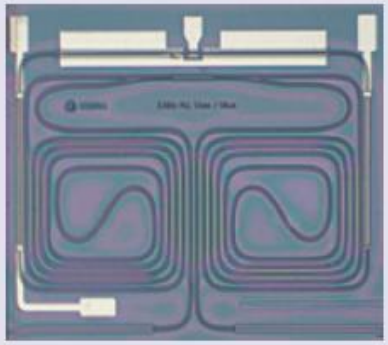


All-optical regenerator for constant envelope WDM signals

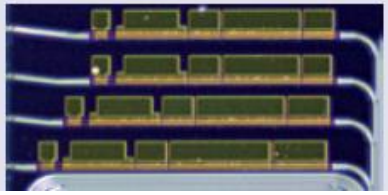
Variety of lasers



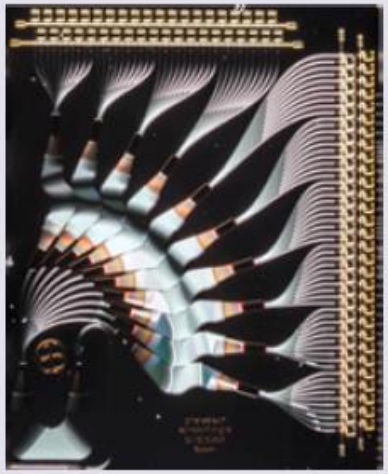
Widely tunable laser



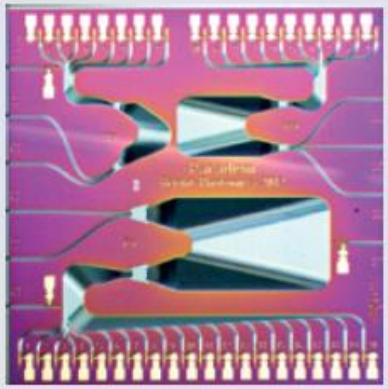
Mode-locked laser



Sensor readout units

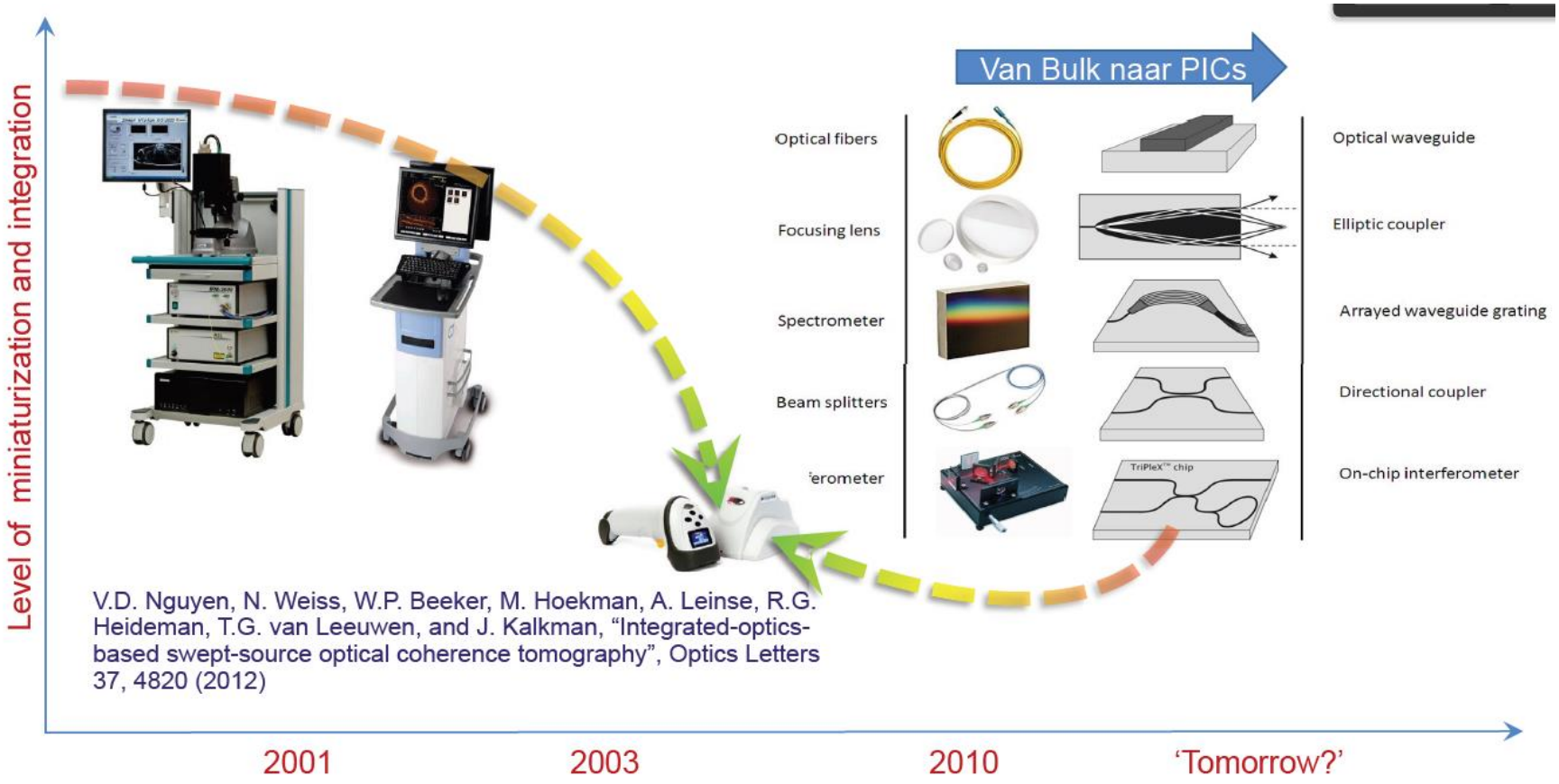


100-channel spectrometer



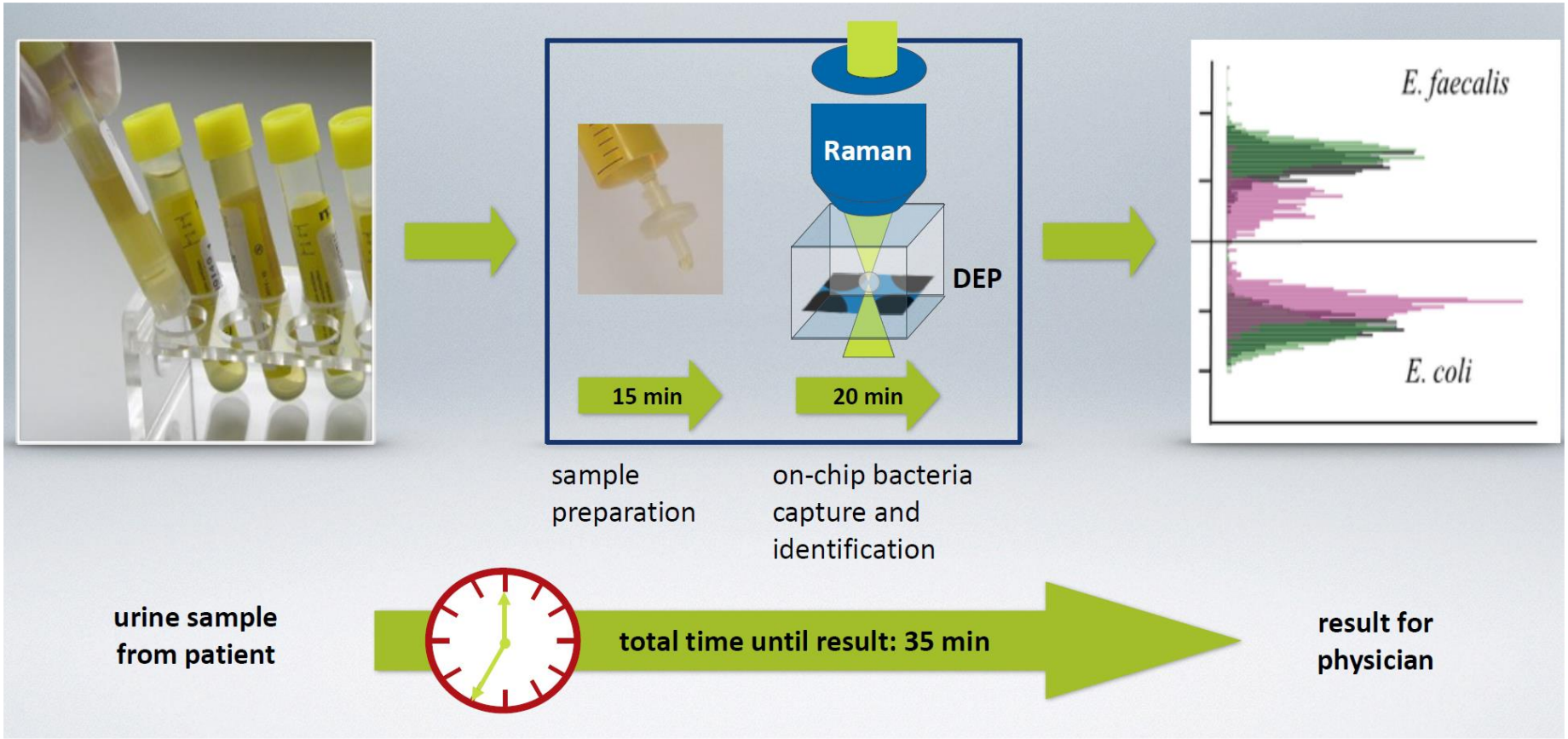
Fibre Bragg grating interrogator

Emerging technologies : PIC for OCT



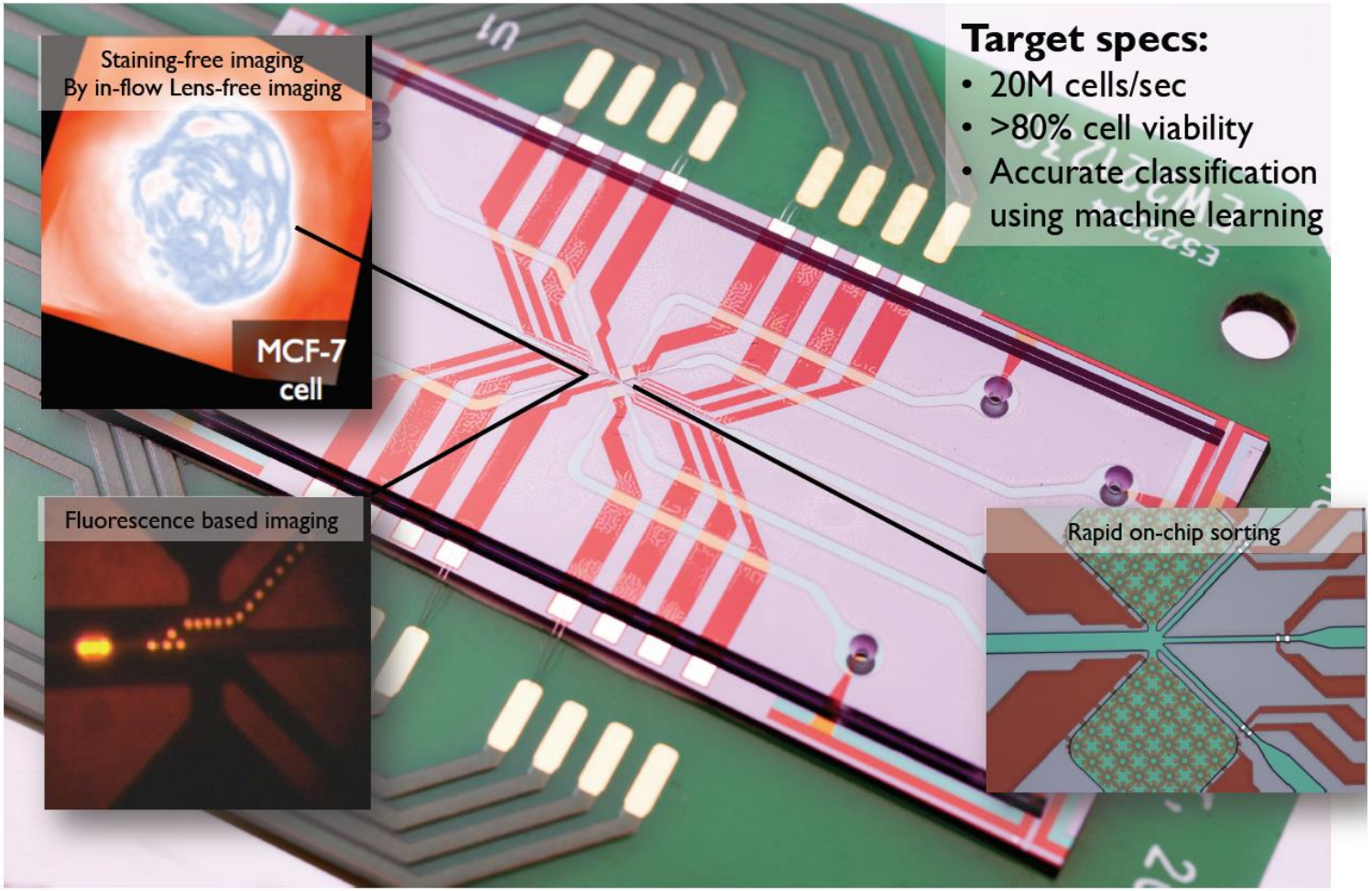
V.D. Nguyen, N. Weiss, W.P. Beeker, M. Hoekman, A. Leinse, R.G. Heideman, T.G. van Leeuwen, and J. Kalkman, "Integrated-optics-based swept-source optical coherence tomography", Optics Letters 37, 4820 (2012)

Identification of bacteria directly from body fluids



Cell Sorting Platform

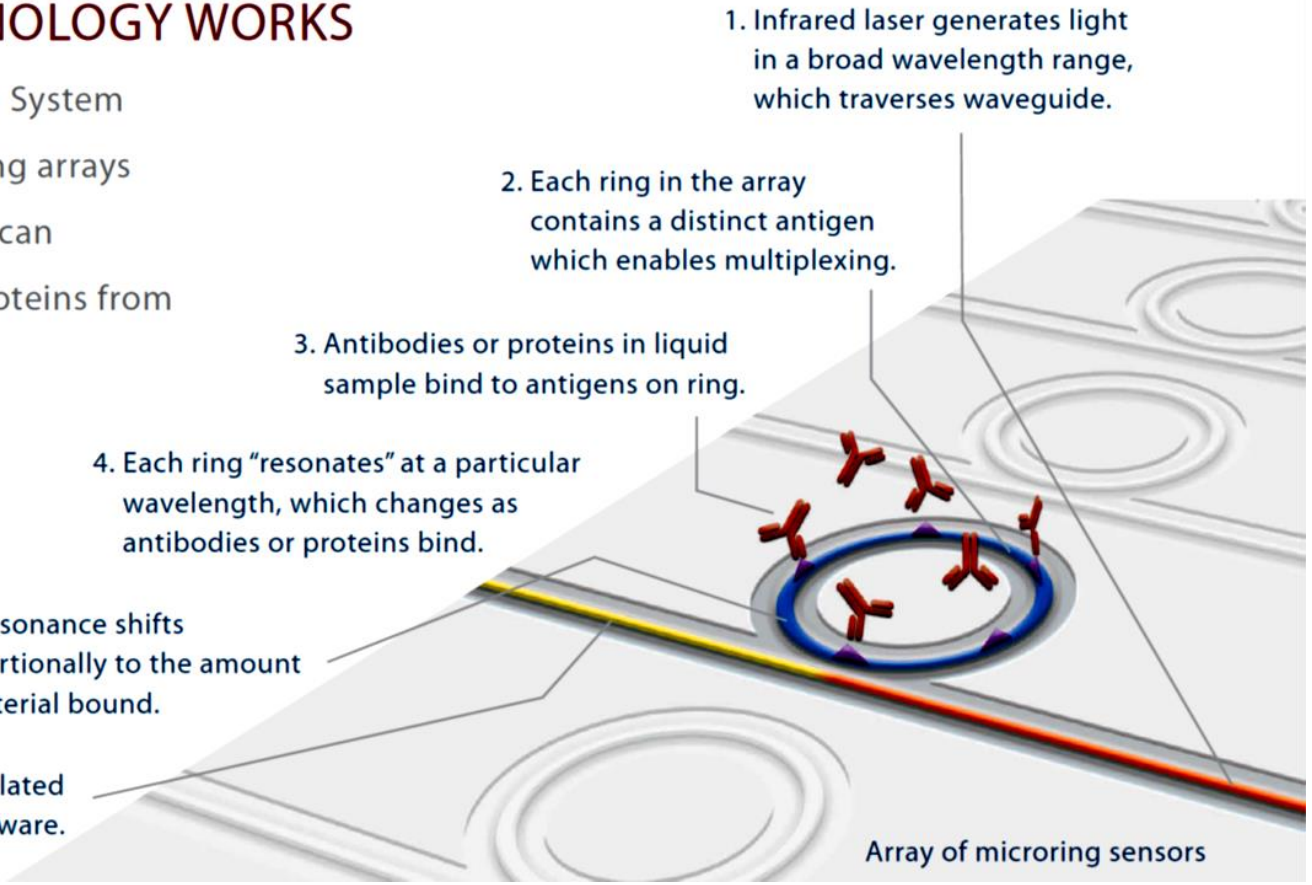
imec



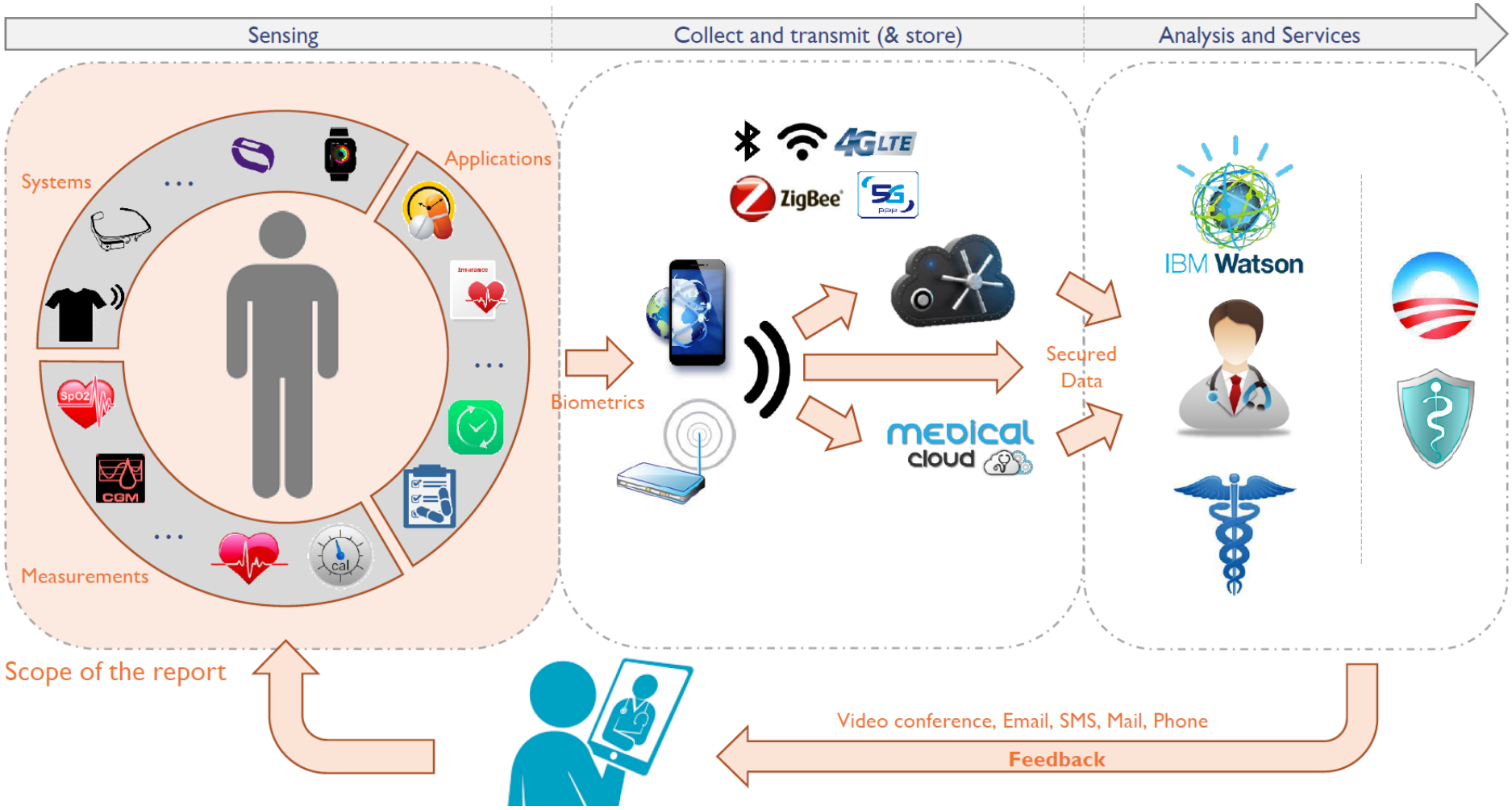
Maverick Technology

HOW MAVERICK™ TECHNOLOGY WORKS

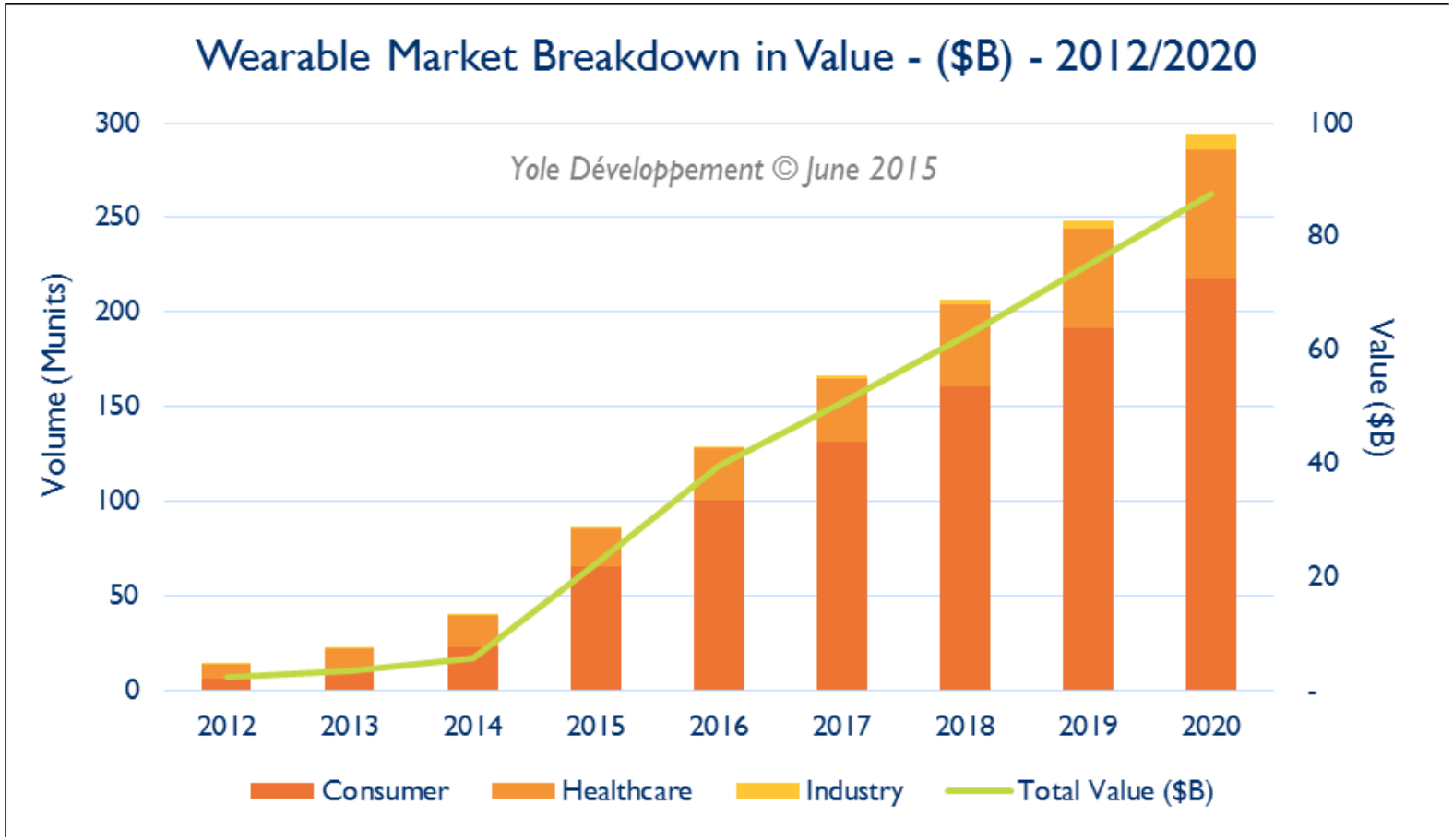
The key to the Maverick™ Detection System is its patented silicon chip containing arrays of photonic Microring Sensors that can simultaneously analyze multiple proteins from a single small sample.



Wearables: an “internet of things” application

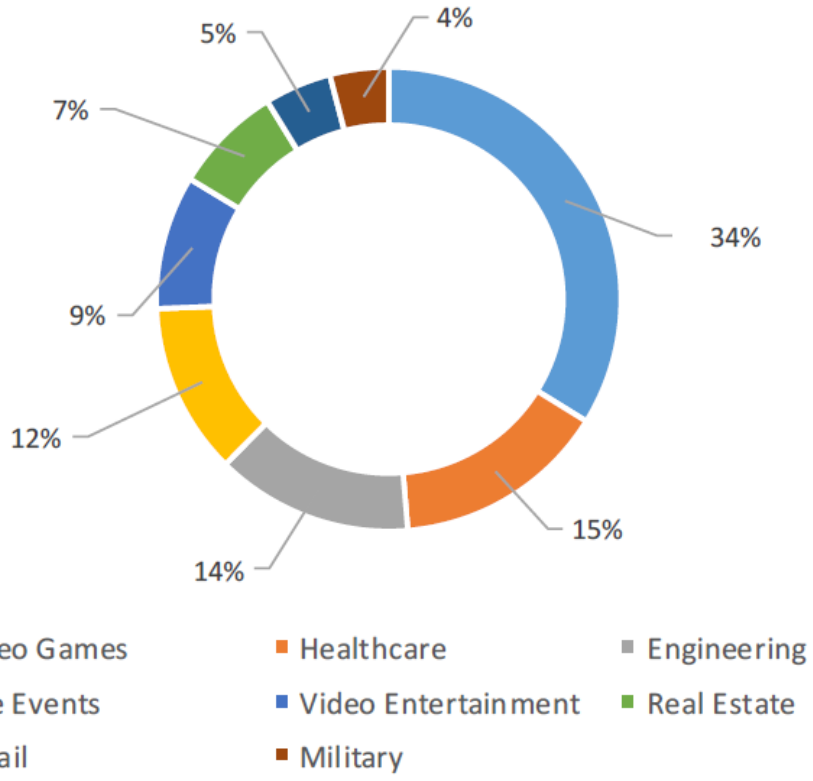


Wearable Market for Consumer and Healthcare

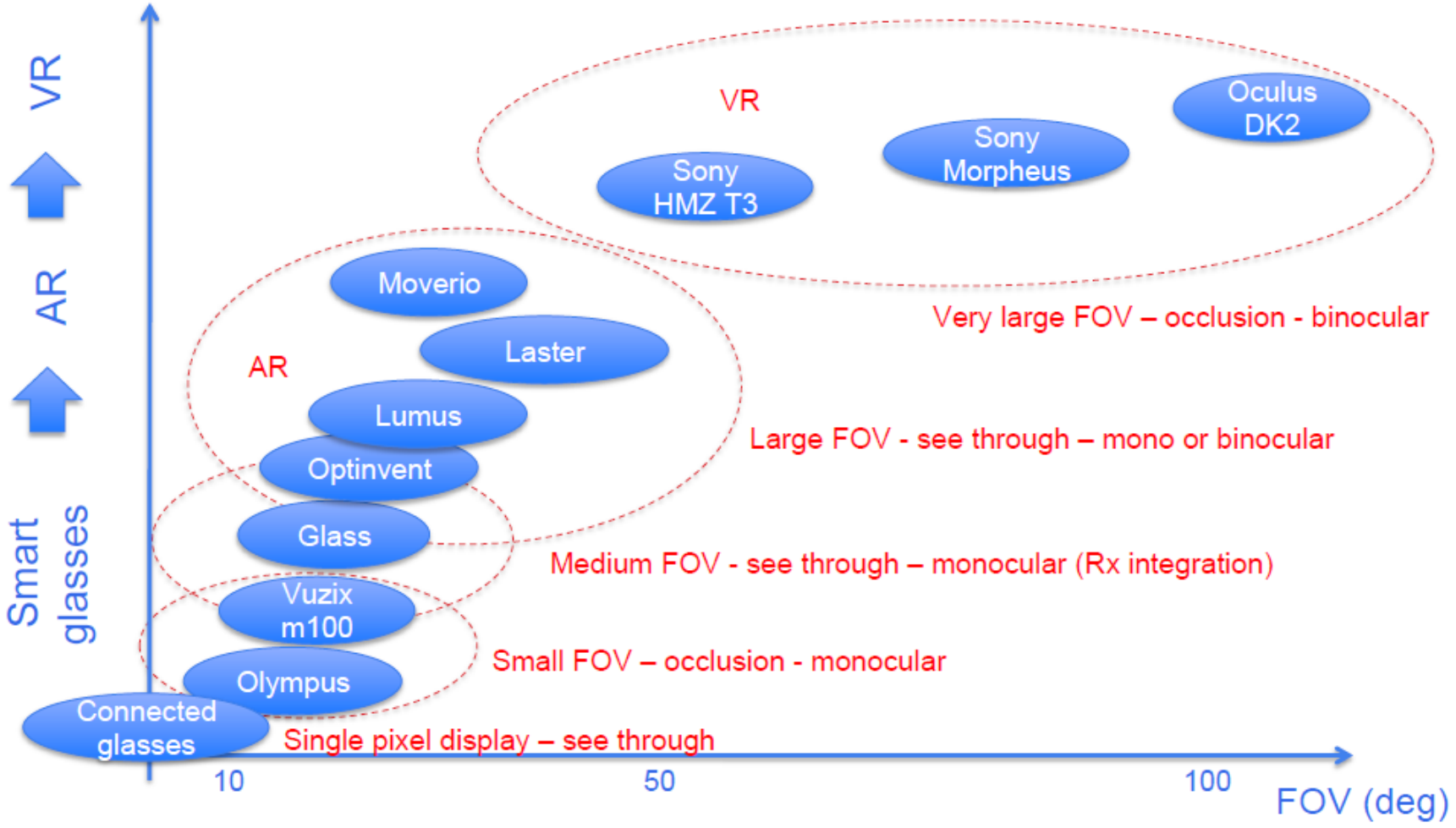


Augmented and Mixed Reality

- By 2025, the Augmented and Mixed Reality market is predicted to expand to $85B.



From smart glasses … to AR and VR



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Summary and Conclusions

Photonics in Healthcare is at a turning point in its evolution, as it prepares to leave the bulky systems market and enter the mass market.

Analysis of this evolution:

- Product prices ranging from $300k - $1M:
  - **Big equipment** for hospitals and analysis laboratories (X-ray scanners, high-resolution microscopes, bulky cytometers, etc.)
  - **Little biophotonics development is expected**
  - Low market growth (3% - 5%)
- Product prices ranging from $10k - $300k:
  - Systems for the life science market
  - **Compact systems** for diagnostics and monitoring in doctor's office (i.e. OCT for ophthalmologists, endoscopes for gastroenterologists).
  - Current market growth: 8% - 10%, but will slow in 5 - 10 years

Summary and Conclusions

- Product prices ranging from $1 - $1,000:
  - Small, portable, easy-to-use devices for home and personalized use
  - Small market today, but **high growth is expected** (15 - 20%)
  - Development in Micro/Nanophotonics and Photonics Integrated Circuits is necessary
  - Two co-existing applications reside in this market:
    - *Devices for **welfare** (gadgets, smartphone applications, etc.) with no "medical value". The first products in this category are already on the market.*
    - *Devices for **home diagnostics and monitoring** (glucose measurements, heart monitoring, etc.) providing highly reliable medical information. Large investments are necessary for developing **cheap AND reliable** systems.*

Thank You !

Exploration of Photonics markets

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