

A young child is smiling and holding a glowing light stick at a night festival. The background is filled with colorful bokeh lights in shades of blue, green, and yellow. The child is wearing a light-colored t-shirt with a graphic design.

# Data Science Platform and Highly Scalable Cloud-based Framework for HealthTech Data Processing

**François Andry PhD, Senior Director**

Teratec Forum 2017

**PHILIPS**

# Touching lives around the globe

**190**  
**million**  
**patients**

tracked with our  
patient monitors  
last year

Present in

**100 countries**

with 450+ products and services

**1,000,000**

patients monitored in their  
**homes every day**

**100+ years**

of **listening deeply** to customers  
to understand what really matters

**100,000+**

professionals are supported  
with **education**

**+970 million people**

in emerging markets around the world now have **access**  
to Philips diagnostic imaging

**10 petabytes**

of data **managed** for  
health care providers

# Solutions for the Health continuum



Personal health

Aging in place

Hospital to home

Sleep

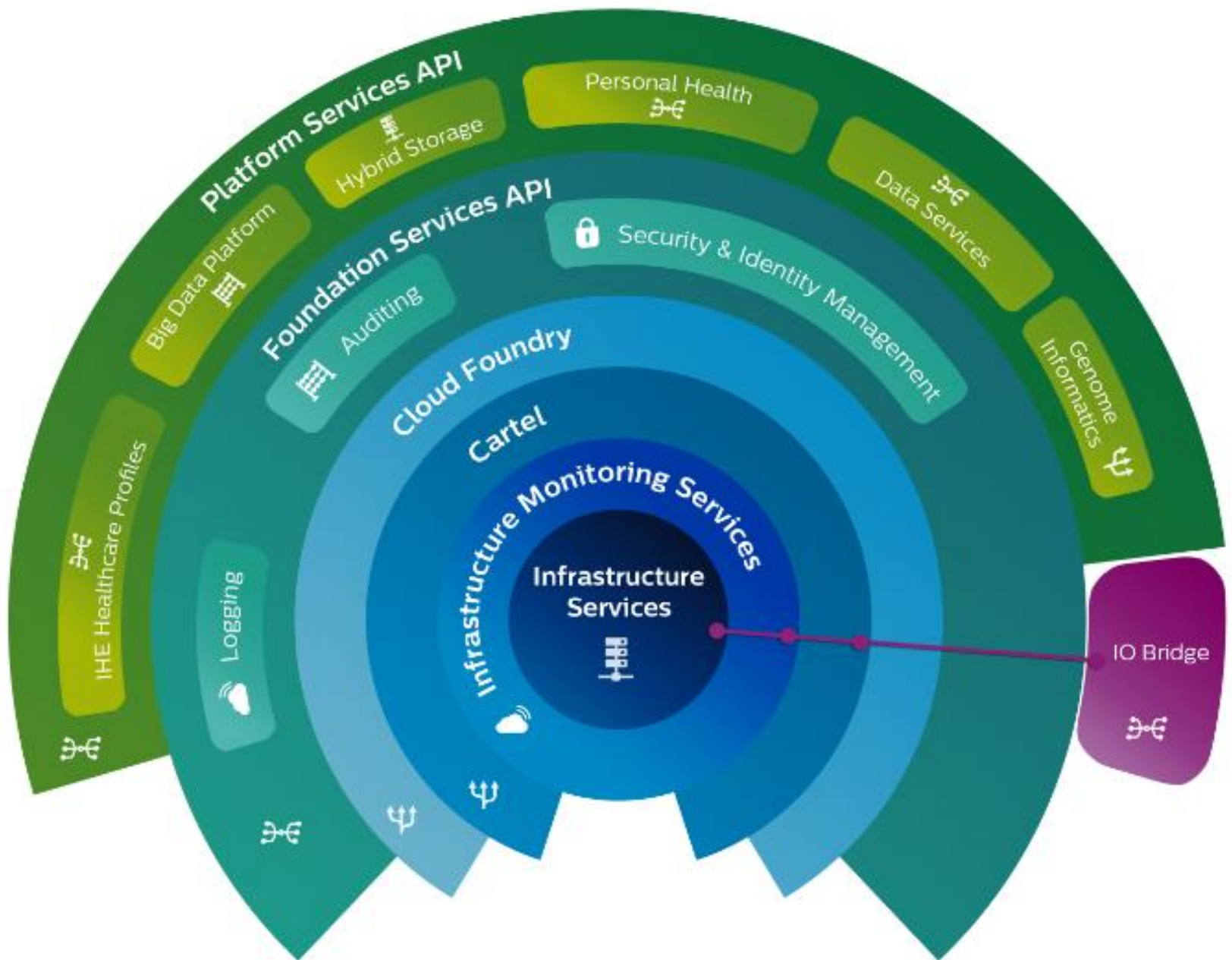
Acute care  
Imaging diagnostics & intervention

Healthcare operations

Digital Health Platform – enabling solutions

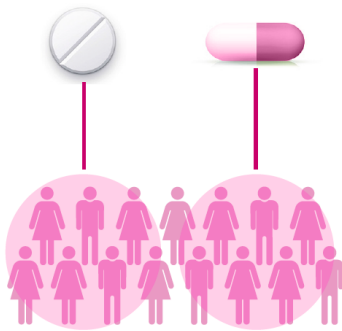
# Philips Propositions

Healthy Living	Prevention	Diagnosis	Treatment	Recovery	Home Care
 <p data-bbox="170 644 336 668">Personal Care</p>	 <p data-bbox="423 868 645 892">Health &amp; Wellness</p>	 <p data-bbox="929 551 1136 575">Imaging Systems</p> <p data-bbox="784 983 1031 1008">Genome Informatics</p>	 <p data-bbox="1193 668 1512 692">Patient Care &amp; Monitoring</p>	 <p data-bbox="1586 772 1802 796">Home Healthcare</p>	 <p data-bbox="1373 1082 1493 1139">Customer Services</p>



# Genetic heterogeneity

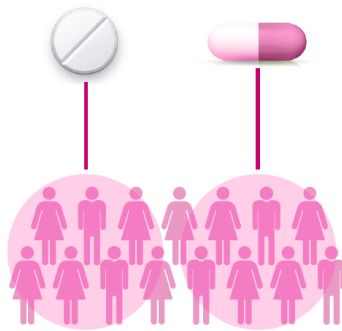
Current practice



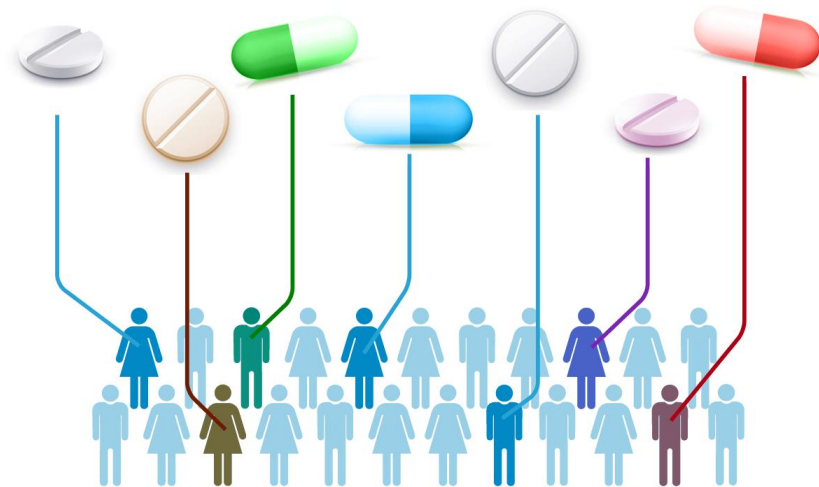
One size fits all

# Genetic heterogeneity

Current practice



One size fits all



Genomically-enabled personalized medicine



Satellite View



Airplane View



Street View





Satellite View

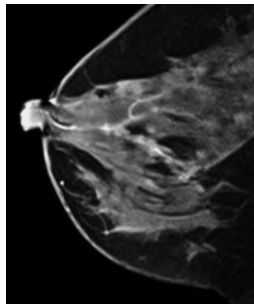


Airplane View

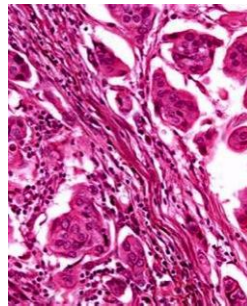


Street View

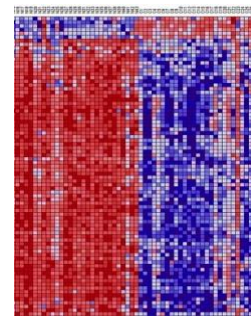
**Imaging Systems**



**Digital Pathology**



**Genome Informatics**





Intergalactic View



Satellite View



Airplane View

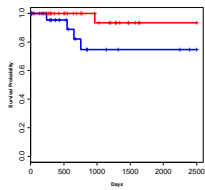


Street View

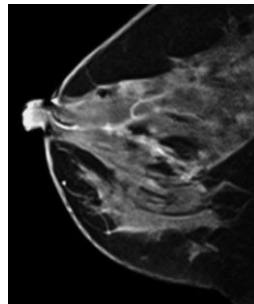


House View

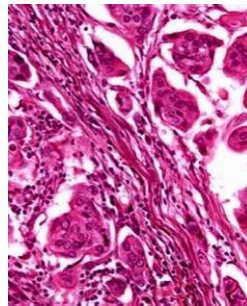
### Population Health



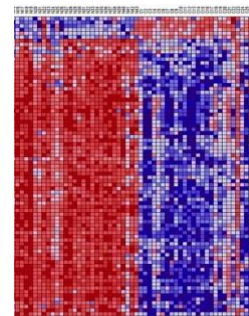
### Imaging Systems



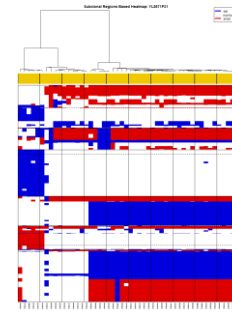
### Digital Pathology



### Genome Informatics

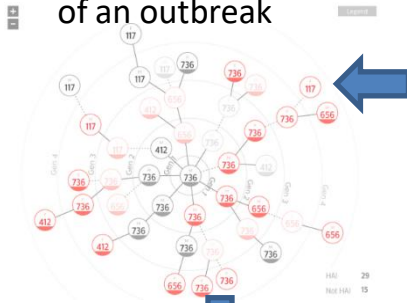


### Single Cell

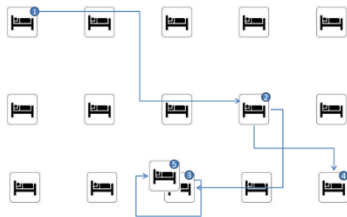


## Genomics for Infectious Disease

Phylogenetic tree of an outbreak

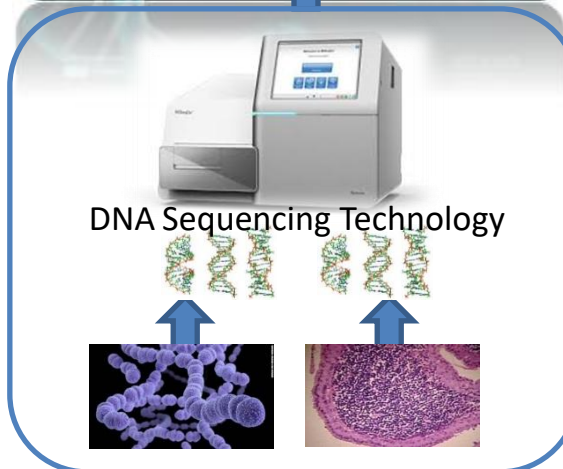


Transmission route



Molecular Epidemiology identifying infection spread

## HSDP Core Genomics Platform

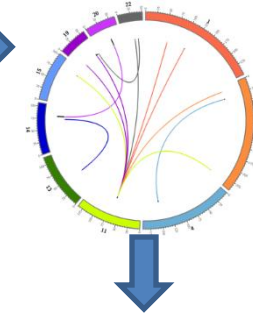


DNA Sequencing Technology

Bacteria / Tumor prepared samples

## Genomics for Oncology

Genomic fingerprint: mutations, fusions



Actionable information

Gene	Variant	Transcript	Association/Effect	Disease Name	Drug	Population	Mechanism of Action	Association Evidence
CCNE1	34102818	Intron		Cervix Uteri Cancer	Capecitabine	ASU	EGFR/HER2/VEGFR Inhibitor	200810
CCNE1	34102818	Non-coding		Cervix Uteri Cancer	Docetaxel	ASU	Immunomodulator	162114
CCNE1	34102818	Intron		Cervix Uteri Cancer	Docetaxel	ASU	Immunomodulator	162114
CCNE1	34102818	Non-coding		Cervix Uteri Cancer	Docetaxel	ASU	Immunomodulator	162114

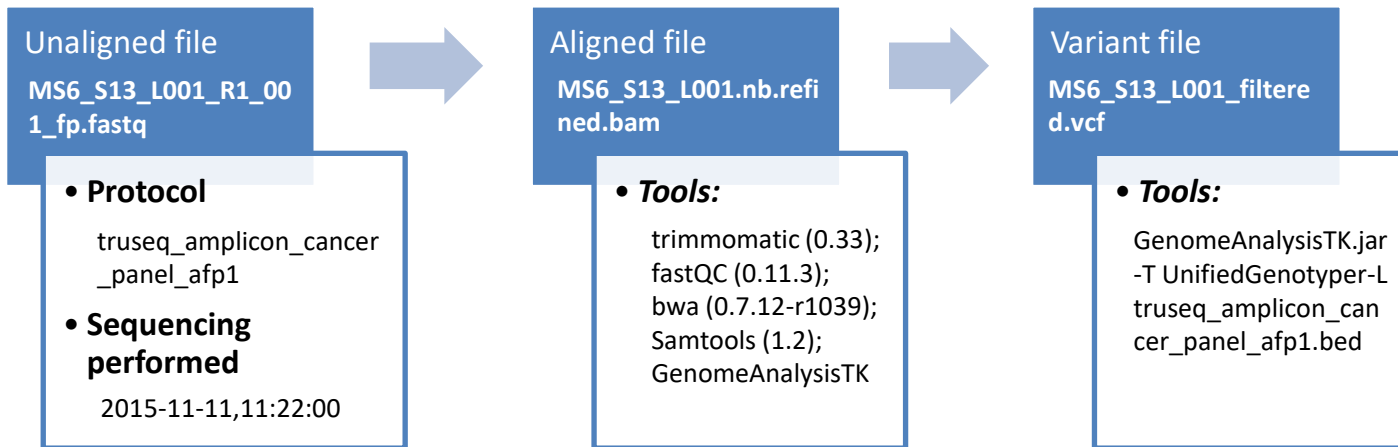
  

Gene	Variant	Association/Effect
FBXW7	122545762	Deletion
CCNE1	34102818	Deletion
CCNE1	34102818	Deletion
CCNE1	34102818	Deletion

Personalized Therapy selection for cancer patients

Characterization	Storage (raw data)	Storage (processed data)	RAM	CPU (2.6GHz)	CPU (Philips)
Targeted exome 500 genes 500x	4-8GB	8-16GB	4-20GB	days	30mn
Whole exome 100x	20-40GB	4-80GB	4-20GB	weeks	6-8hr
Targeted 500 translocations 500x	4-8GB	8-16GB	4-20GB	days	1hr
Targeted transcriptome > 400x	2-4GB	4-8GB	1-4GB	days	1hr
Whole transcriptome 100x	10-20GB	20-40GB	4-20GB	days	2-8hr
Whole genome 30x normal 100x tumor	0.5-1TB	1-2TB	4-20GB	months	days





# Asynchronous processing API

<b>POST</b> <i>/genomics-processing/Step</i> .....
<b>GET</b> <i>/genomics-processing/Step/{step-id}</i> .....
<b>GET</b> <i>/genomics-processing/Step</i> .....
<b>POST</b> <i>/genomics-processing/Pipeline</i> .....
<b>GET</b> <i>/genomics-processing/Pipeline/{pipeline-id}</i> .....
<b>PUT</b> <i>/genomics-processing/Pipeline/{pipeline-id}</i> .....
<b>GET</b> <i>/genomics-processing/Pipeline</i> .....
<b>POST</b> <i>/genomics-processing/Mission</i> .....
<b>GET</b> <i>/genomics-processing/Mission/{mission-id}</i> .....
<b>PUT</b> <i>/genomics-processing/Mission/{mission-id}</i> .....
<b>GET</b> <i>/genomics-processing/Mission</i> .....
<b>POST</b> <i>/genomics-processing/MissionExecution</i> .....
<b>GET</b> <i>/genomics-processing/MissionExecution/{missionExecution-id}</i> .....
<b>DELETE</b> <i>/genomics-processing/MissionExecution/{missionExecution-id}</i>
<b>POST</b> <i>/genomics-processing/Executable</i> .....
<b>GET</b> <i>/genomics-processing/Executable/{executable-id}</i> .....
<b>GET</b> <i>/genomics-processing/Executable</i> .....
<b>GET</b> <i>/genomics-processing/Runtime</i> .....

# Gateway API

**GET** */genomics/Mission/{mission-id}* .....

**POST** */genomics/MissionExecution* .....

**GET** */genomics/MissionExecution/{mission-execution-id}* .....

**POST** */genomics/MissionExecutions* .....

**POST** */genomics/MissionExecution/\$qc-metrics* .....

**POST** */genomics/MissionExecution/\$mlst* .....

**POST** */genomics/MissionExecution/\$phylo-tree* .....

**GET** */genomics/MissionExecution/{mission-execution-id}/\$phylo-tree* .....

**POST** */genomics/MissionPackage* .....

**GET** */genomics/MissionPackage/{package-id}* .....

**GET** */genomics/MissionPackage/{package-id}/\$export* .....

**POST** */genomics/MissionPackage/\$import* .....

**GET** */genomics/BioSequence* .....

**POST** */genomics/Pathogen/{pathogen-id}/{limits-filename}* .....



# Pipeline Definition

PHILIPS Genomics Admin Settings Help genomics

Configuration Missions in Execution Search

**TruSeq**

Description  
TruSeq pipeline

Reference Files  
References;ref.zip

Flow  
[Show Details...](#)

[Upload References Set](#) [New pipeline](#) [Edit](#)

FLOW

```

graph LR
    Run_fastqc[Run_fastqc  
fastqc  
0 1 2] --> bwa_mem[bwa_mem  
bwa_shell  
2]
    bwa_mem --> samtools_view[samtools_view  
sam_view]
    samtools_view --> sam_sort[sam_sort  
sam_sort]
    sam_sort --> samtools_flagstat[samtools_flagstat  
sam_flagstat]
    sam_sort --> Refine_bam[Refine_bam  
refine_bam  
2]
    samtools_flagstat --> Get_flagstat_values[Get_flagstat_values  
parse_flagstat  
2]
    Refine_bam --> samtools_mpileup[samtools_mpileup  
sam_mpileup  
2]
    Refine_bam --> sam_bed_coverage[sam_bed_coverage  
sam_bedcoverage  
3 2]
    samtools_mpileup --> varscan_mpileup[varscan_mpileup  
varscan_snp]
    sam_bed_coverage --> amplicon_coverage_QC[amplicon_coverage_QC  
amp_coverage  
2]
    varscan_mpileup --> variant_filtering[variant_filtering  
variant_filter  
2]
    amplicon_coverage_QC --> variant_filtering
    
```

Id	Description	References	Version	Create Date
efaecium_mlst		E_faecium;efaecium_mlst.fa, E_faecium;efaecium_mlstAlleles.txt, E_faecium;efaecium.txt, E_faecium;mlst_limits.txt	0	May 1, 2016 at 07:21
efaecium_pipeline		E_faecium;E_faecium_E39.fa	0	May 1, 2016 at 07:21
TruSeq	TruSeq pipeline	References;ref.zip	0	May 3, 2016 at 15:18

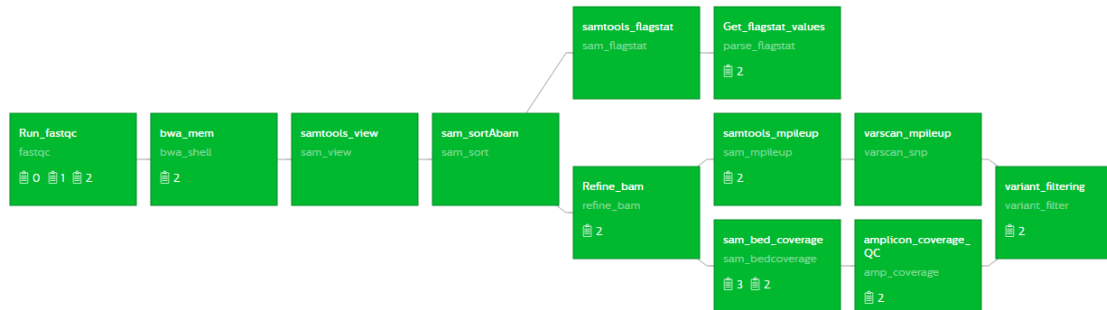
# Mission Execution

## TruSeq (v.0) - Succeeded

Execution ID: idh3.ea570bfc-878c-4fc9-94fc-cfec15f60e4e  
 Submit Date: May 19, 2016 at 11:03

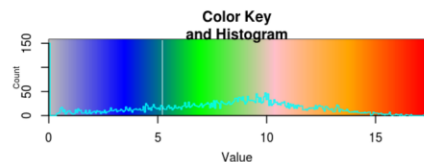
Stop View files... Additional Capabilities...

In progress  Not Executed

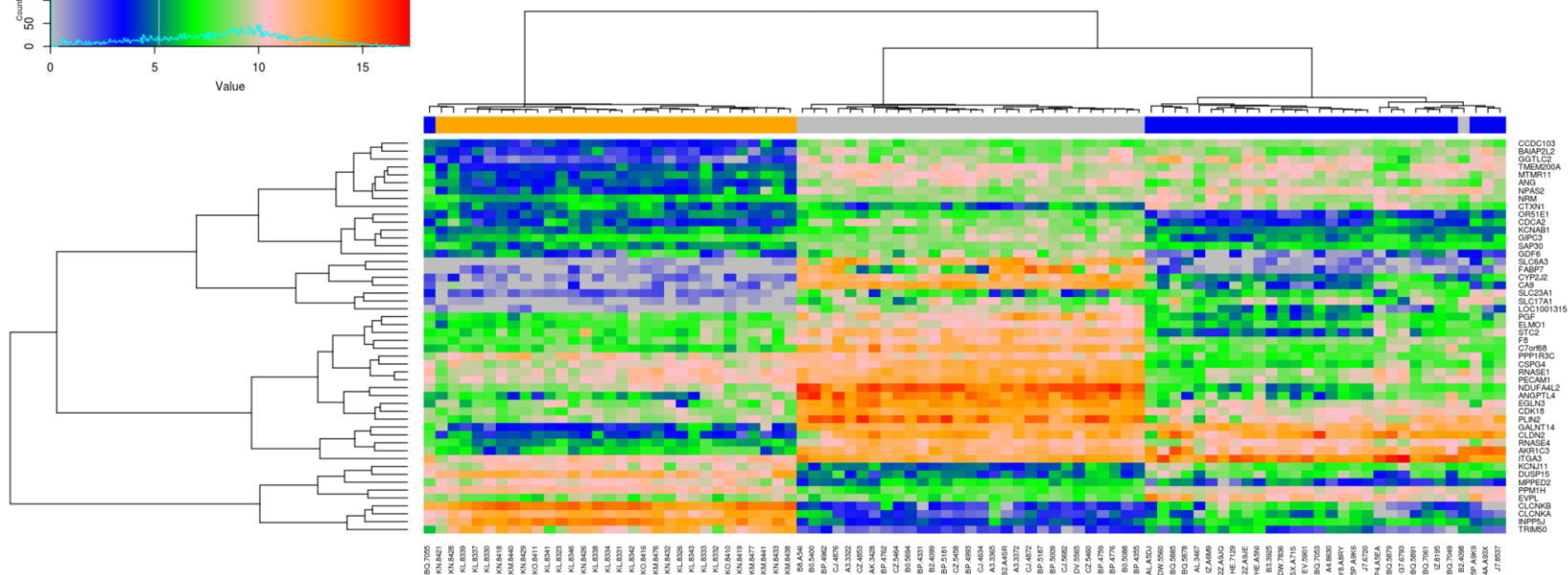


ID	Mission Name	Status	Submit Date
idh3.ea570bfc-878c-4fc9-94fc-cfec15f60e4e	TruSeq (v.0)	Succeeded	May 19, 2016 at 11:03
idh2.3dfed16e-ab0e-4a6a-a129-ee9654f23474	TruSeq (v.0)	Succeeded	May 19, 2016 at 11:02
idh1.d682cff2-9421-440b-acce-ca583f8985e9	TruSeq (v.0)	Succeeded	May 19, 2016 at 11:02
IDH2.57ea03b4-6318-4912-bf41-b1401b91b5e1	TruSeq (v.0)	Succeeded	May 19, 2016 at 10:18
IDH1.8ca8f82d-c703-4815-8562-f8bdabc6d479	TruSeq (v.0)	Succeeded	May 19, 2016 at 10:17
IDH1.744a4664-0bac-48f5-ab84-bd9862e6f91c	TruSeq (v.0)	Succeeded	May 19, 2016 at 09:30
IDH2.89ea70cf-8fd5-4588-8526-92b524e56ca1	TruSeq (v.0)	Succeeded	May 19, 2016 at 00:37
IDH1.9c5bd2a8-2eb4-455e-8ad8-bb717633ae01	TruSeq (v.0)	Succeeded	May 19, 2016 at 00:36



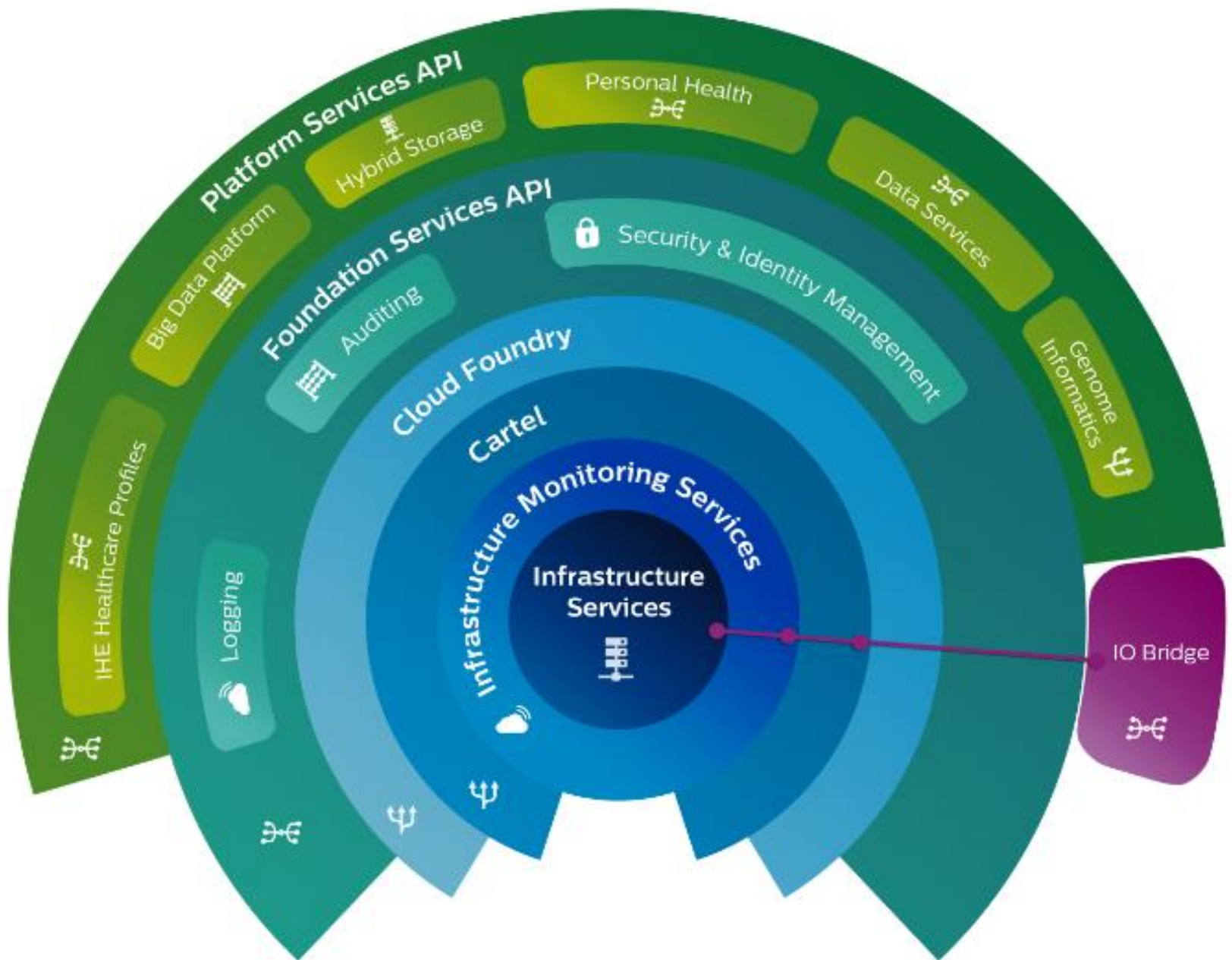


**RCC Clustering based Genes Selected by Largest Subtype Classification Significance**



**Confusion matrix:**

	KICH	KIRC	KIRP	class.error
KICH	30.00	0.00	0.00	0.00
KIRC	0.00	29.00	1.00	0.03
KIRP	1.00	0.00	29.00	0.03



# Ultrasound & Modelization



2D slice



3D rendered - TrueView

11 cm

# Ultrasound & Modelization



2D slice



3D rendered - TrueView

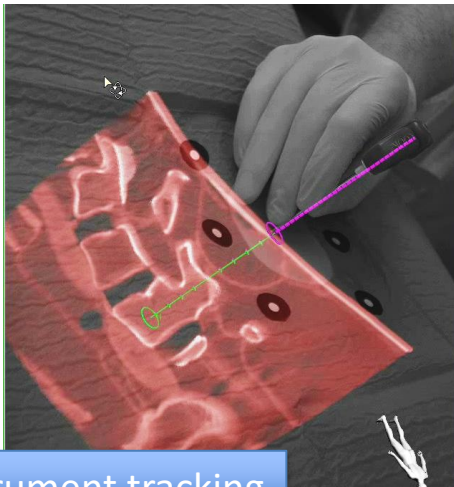
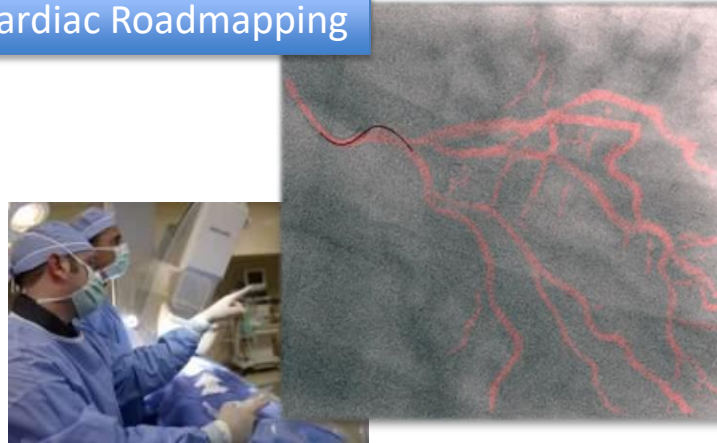
11 cm



nuchal translucency

# Guided Therapy

Cardiac Roadmapping



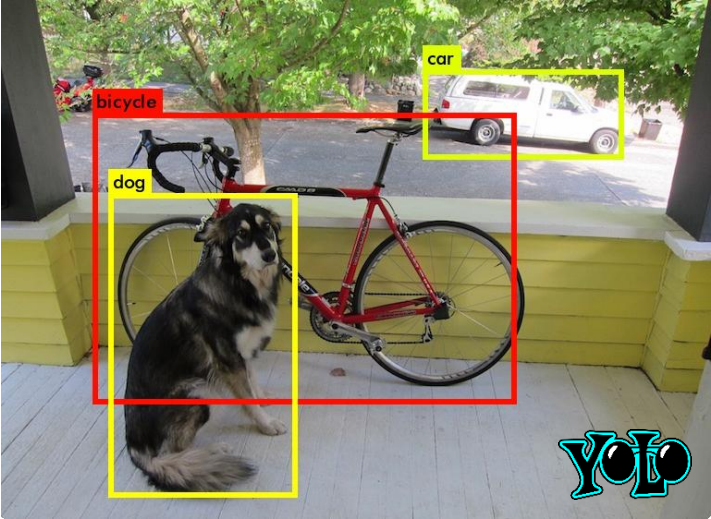
Instrument tracking

EmboGuide

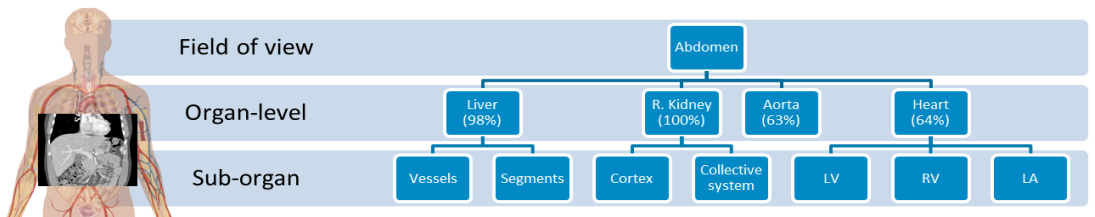
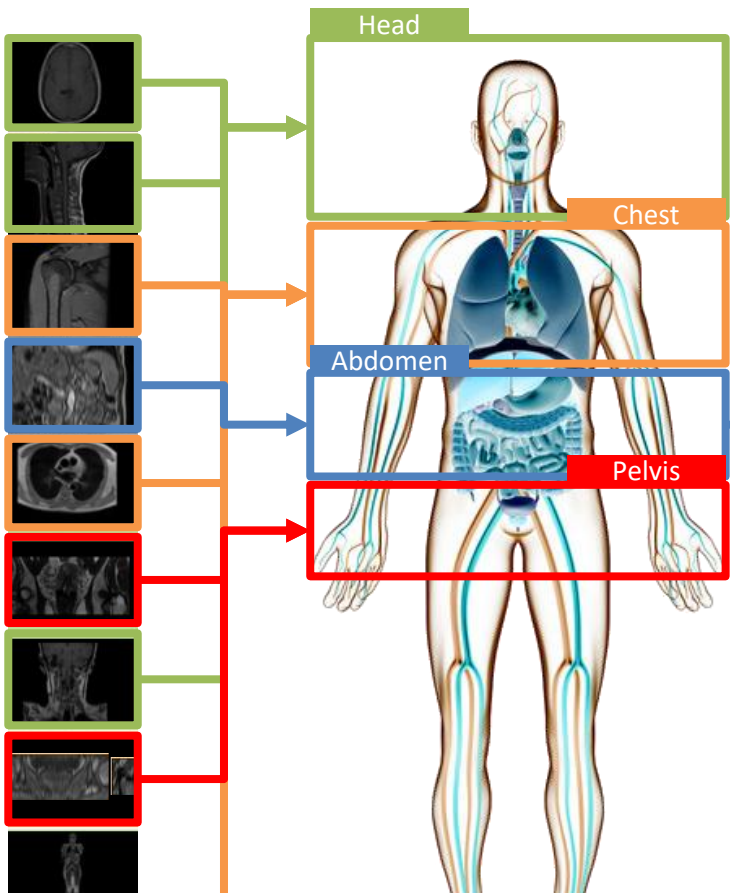
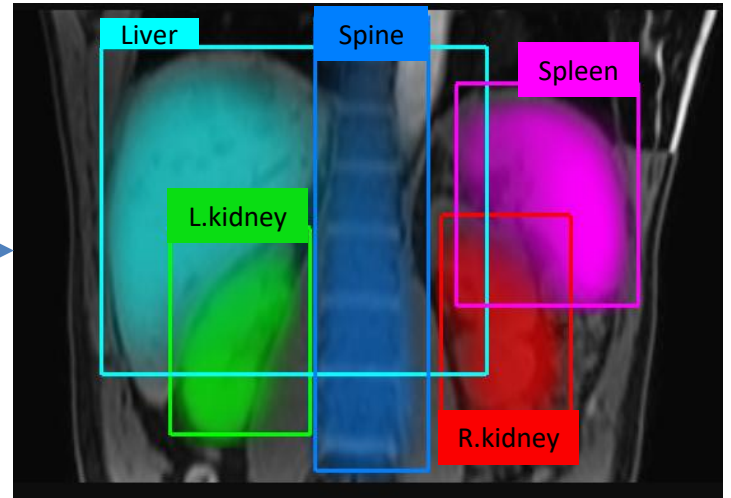
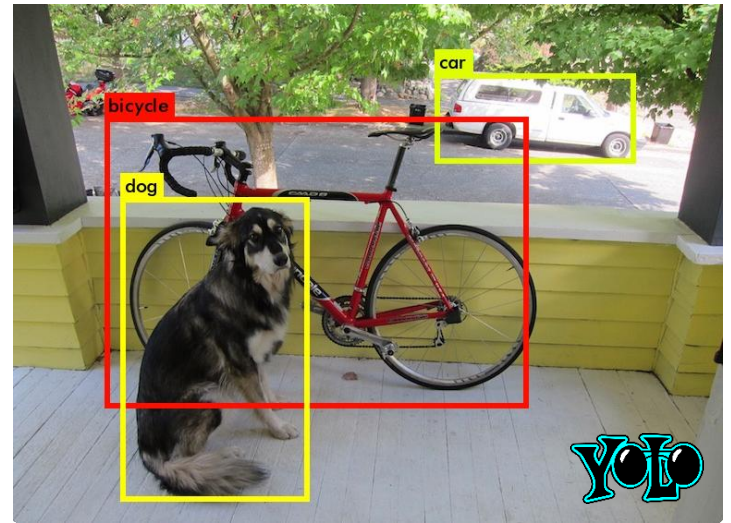




# Anatomical Awareness

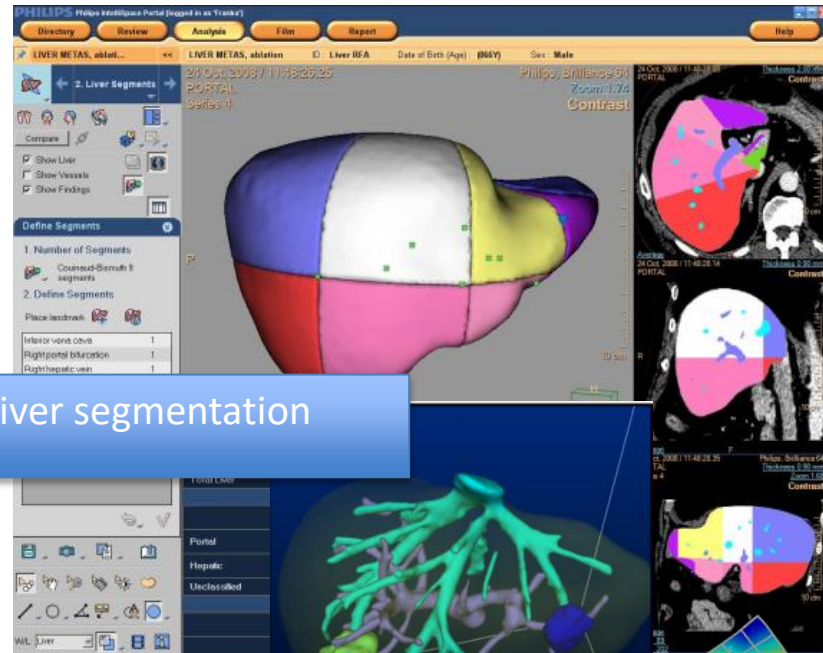
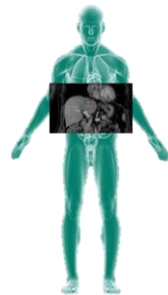
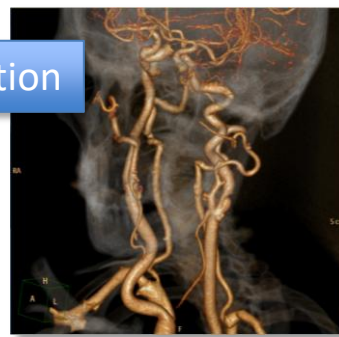


# Anatomical Awareness



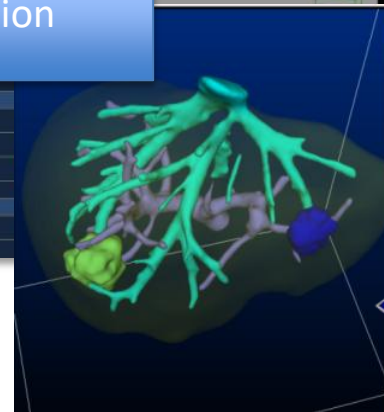
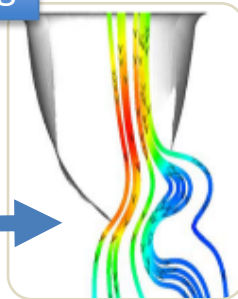
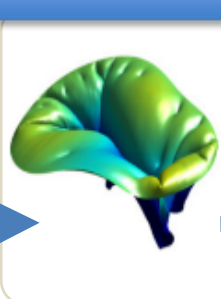
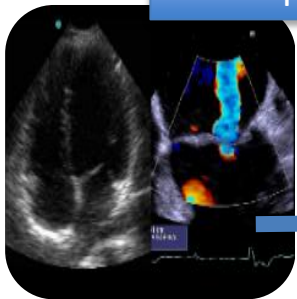
# Organ Segmentation and Modelization

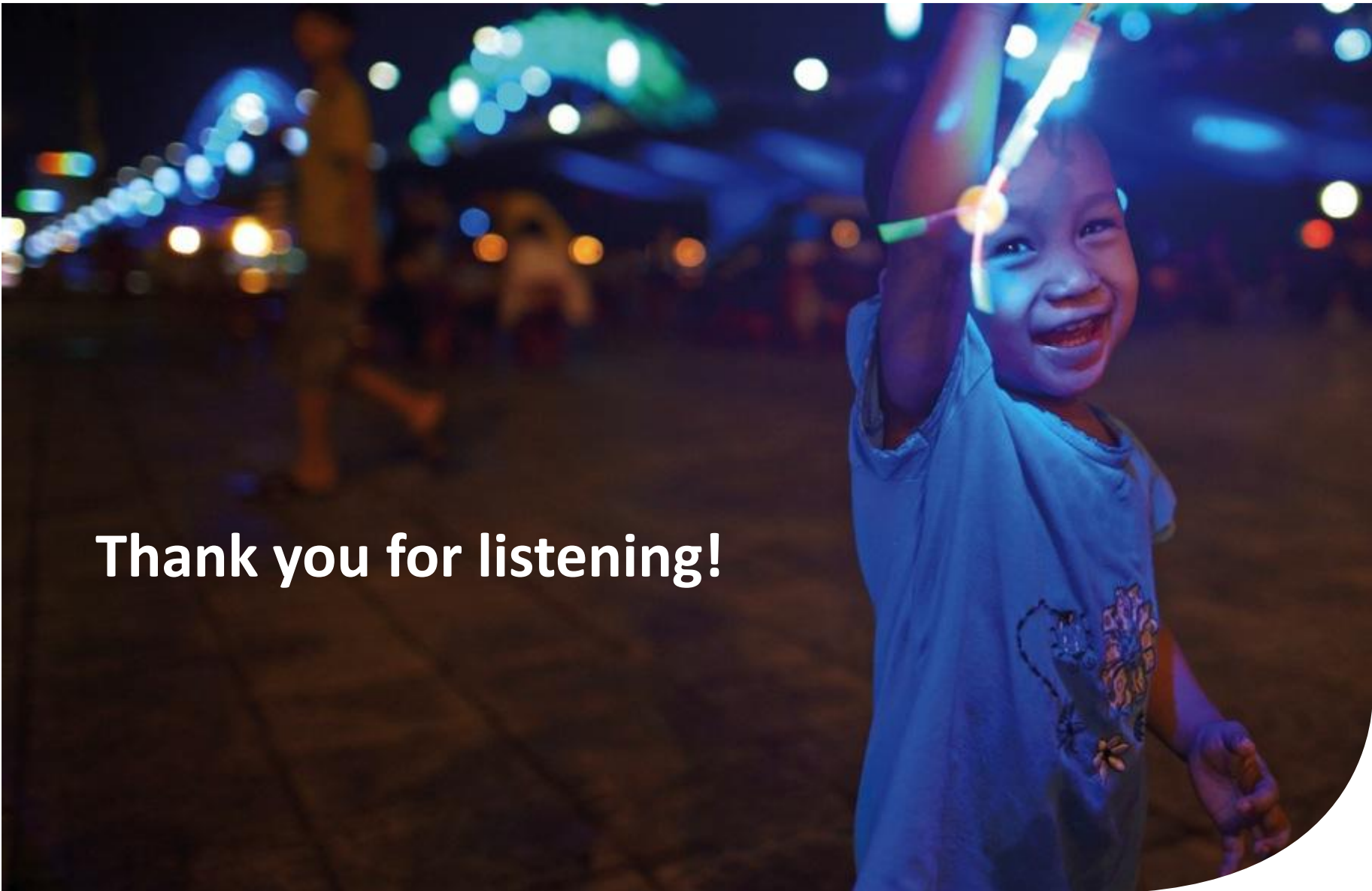
Vessel segmentation



Liver segmentation

PV loop and flow modelling





Thank you for listening!

**PHILIPS**