



# MANIV-DIBH

in routine Radiotherapy practice

- Brussels experience -

AUDAG Nicolas, physiotherapist, PhD

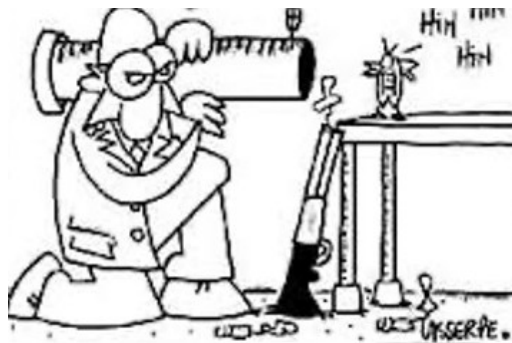
VAN OOTEGHM Geneviève, MD PhD  
[genevieve.vanooteghem@saintluc.uclouvain.be](mailto:genevieve.vanooteghem@saintluc.uclouvain.be)



International Symposium Birmingham 2026  
**Breathing Control for Motion Management**  
in Radiotherapy and Imaging

# Challenges in radiotherapy : mobile tumours

- Target >> Accuracy issues
- OARs >> Protection



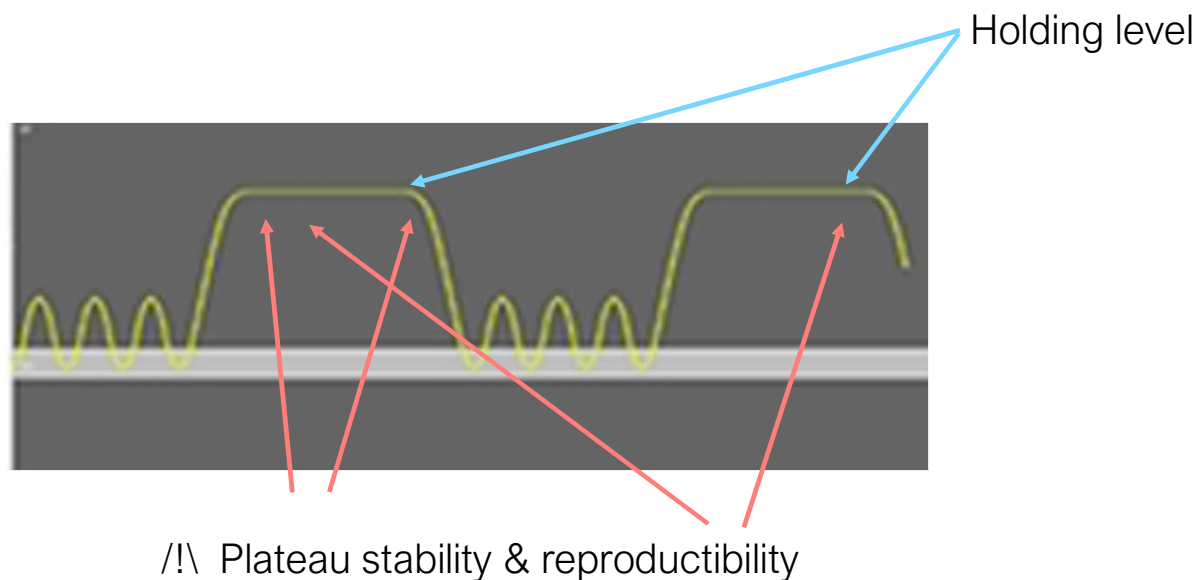
# Challenges in abdominal radiotherapy

- TUMOUR motion ————— ACCURACY
  - 🤔 visibility of tumours
  - 🤔 Internal-external correlation
  - 🤔 Planning 4DCT = snapshot
- ORGANS-AT-RISK motion ————— TOXICITY
  - 🤔 critical OAR —> Stomach, bowel

ACCURACY >> large margins  
but  
TOXICITY >> dose reduction ? Patient eligibility?

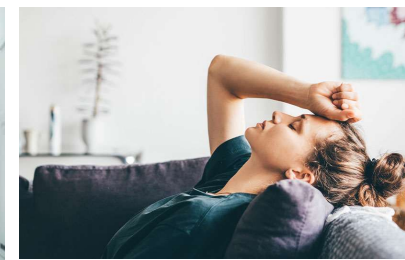
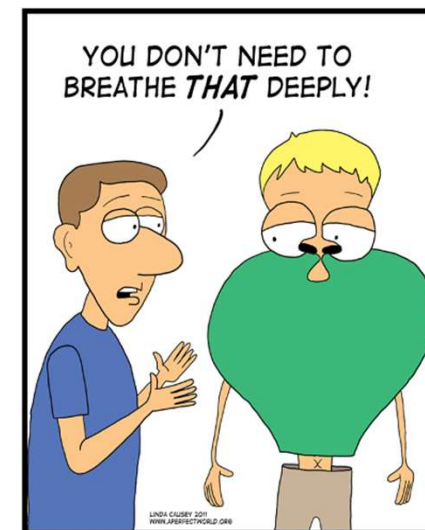
## Other solutions?

- Motion management
  - Margins
  - **Gating >> Breath Hold**
  - Tracking
- Toxicity management?
  - Abdominal compression
  - Prone-position
  - **Gating >> Breath-Hold**



## DIBHs : Drawbacks

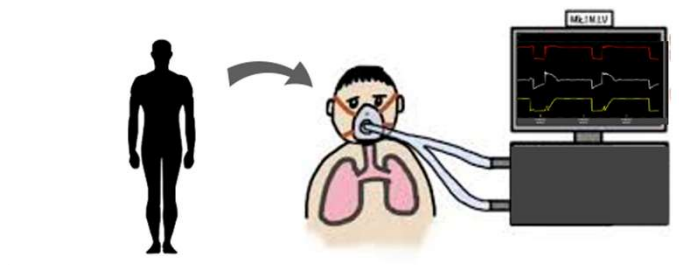
- Patient compliance
  - Age and co-morbidities
  - Anxiety level
  - Fatigue in long-lasting treatments (SBRT)
- Patient responsibility :  
« *patient empowerment* »
- Reproducibility for internal target volumes ( $\neq$  Breast)?



# From *motion* management to *breathing* management : MANIV-DIBH

## Definition

- Mechanical ventilation >> ventilator
- Non-invasive delivery >> face mask
- Patients are fully conscious
- Breathing management : DIBH (2 pressure levels)



## Goals

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- Act/control directly the breathing pattern
- While reproducing what everybody is used to
  - « Optimal » DIBH >> longer and stable/ better inflation
  - Repeated DIBH without free-breathing breaks
- Margin reduction
- OARs protection



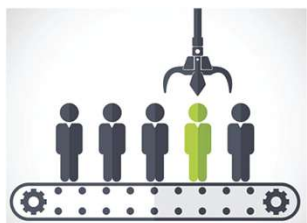
## MANIV-DIBH in routine clinical practice in CUSL

- Research development >> 2017
- [volunteers] —> [patients not during RT] —> [clinical trials during RT] —> **routine**  
2017 2018 2020 2023

## Pre-requisite for clinical implementation

- Quality assessment analysis
  - RO, physicists, RTT, quality manager
- Technical installations
  - 3 ventilators
  - Remote control screen at treatment console
- RTT training
  - 2 cycles of training so far (new RTTs)
  - Ongoing certification
- Expert(s) in ventilation for non-sedated patients : **Physiotherapists**

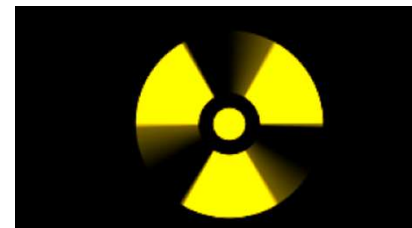
# MANIV-DIBH workflow in practice



Patient selection



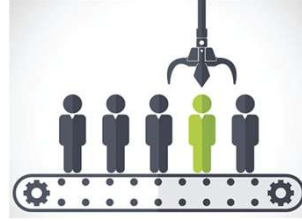
Treatment preparation  
« Planning »



  
Treatment delivery



Follow up



## Patient selection

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- 1st consultation with the RO
  - Treatment explanations
  - Technique explanation
    - Video
    - Brochure

# Clinical indications

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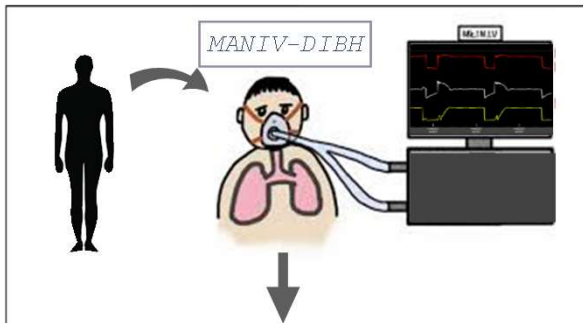
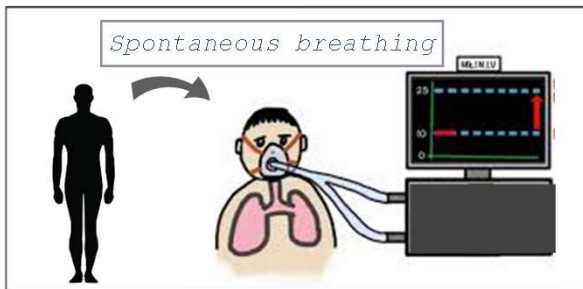
- 2023 : Abdominal « urge »
  - Liver cancers/metastases
  - Pancreatic cancers/metastases
  - Kidney/adrenal glands/lymph nodes/stomach/gastro-esophageal junction
- 2025 : Lung tumours
  - Lower lobes
  - Mid\_lung : Depending on 4DCT motion analysis

# Patient selection

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- Exclusion criteria
  - Claustrophobia (face mask)
  - dys-synchrony
- Inclusion criteria
  - ✓ COPD 1-2
  - ✓ Pulmonary fibrosis
  - ✓ Single lung situation
  - ✓ Cirrhosis (with ascites)
  - ✓ Level of understanding

# Treatment preparation session (simulation)



- MANIV-DIBH coaching ( $\pm$  10 minutes)
  - Meet the physiotherapist/RO (perfusing time)
- Progressive tests
  - Breathing with a ventilator
  - DIBH with progressive pressure levels
  - DIBH duration 10 seconds >> 20 seconds >> 30 seconds
- Definitive ventilator settings registration





# Planning CT

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- Planning CT acquisition
  - RTT-based
  - Ventilator settings >> coaching
  - 20-30 seconds DIBH
  - 3D CT acquisition during a plateau

## Delineation

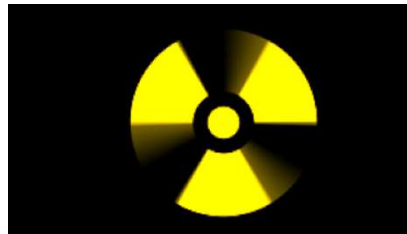
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- « *adios 4DCT and 10 phases delineation* »
- **One single 3D-CT**
- Greater image quality
- Better auto-segmentation

# Planning



- VMAT planning preferred
  - Better synchronisation to MANIV-DIBH
  - No online adaptive planning
- Availability on
  - Halcyon machine (Varian®)
  - Ethos machine (Varian®)
  - To be installed on True Beam (Varian®)

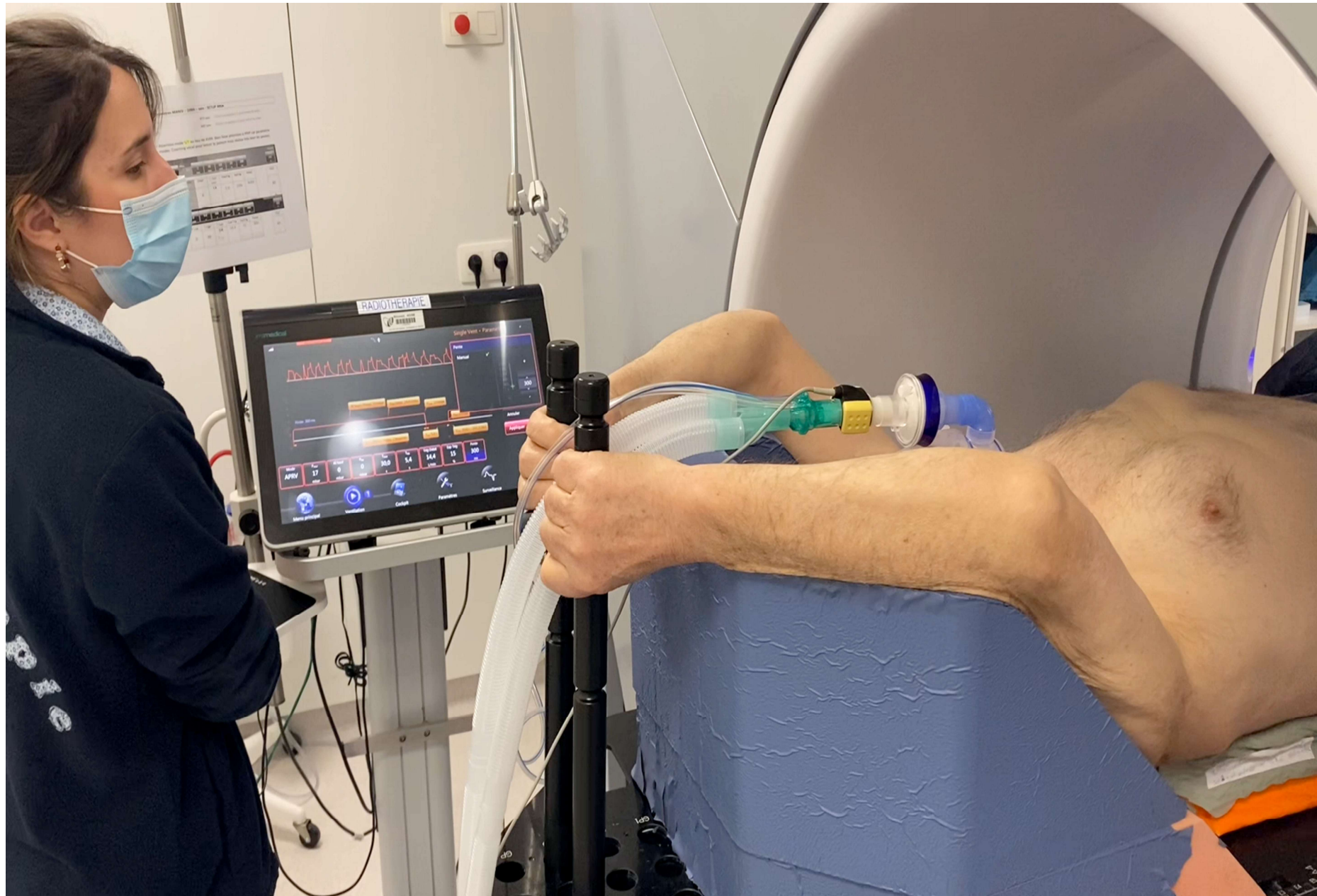


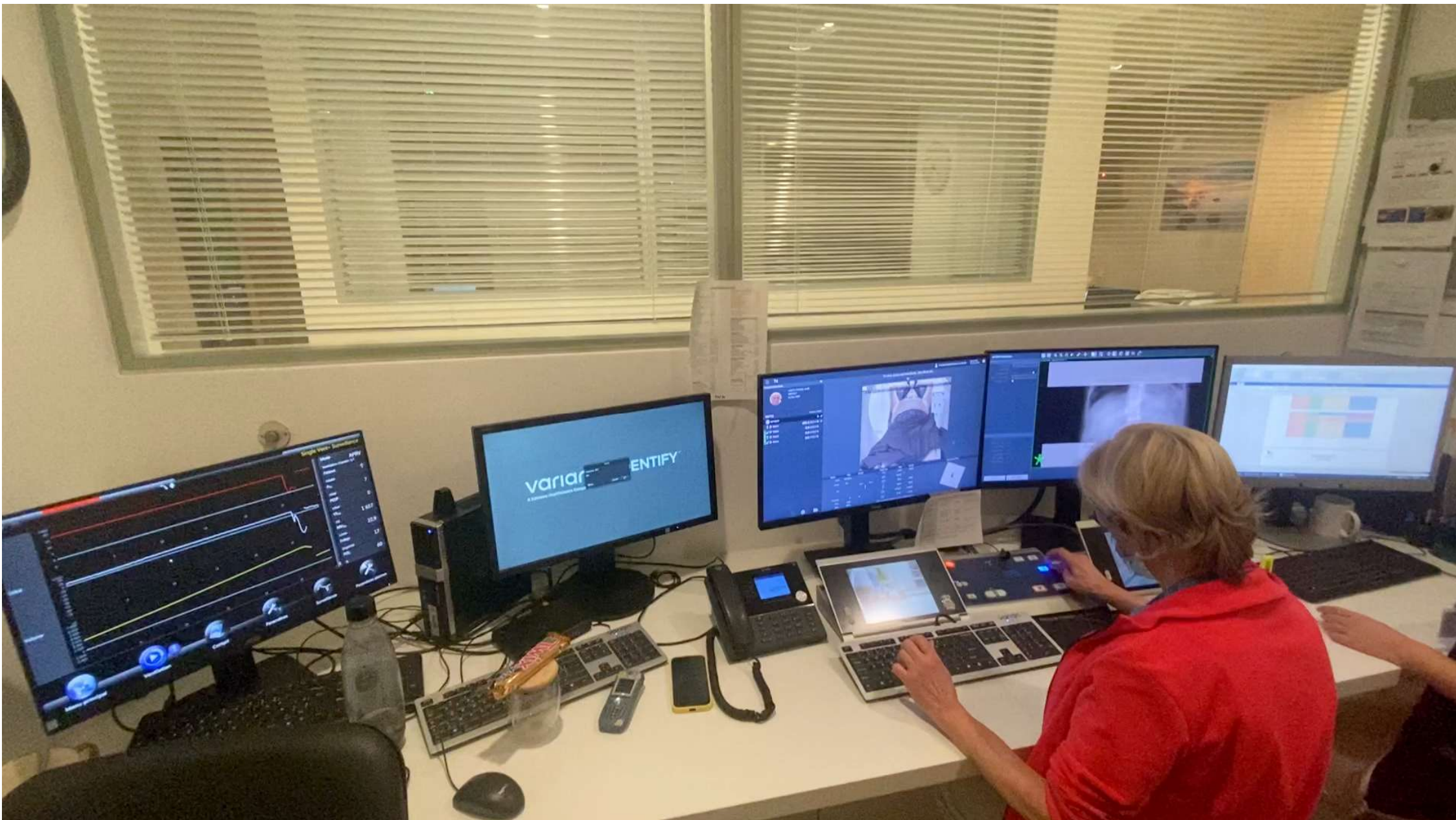
## Treatment delivery

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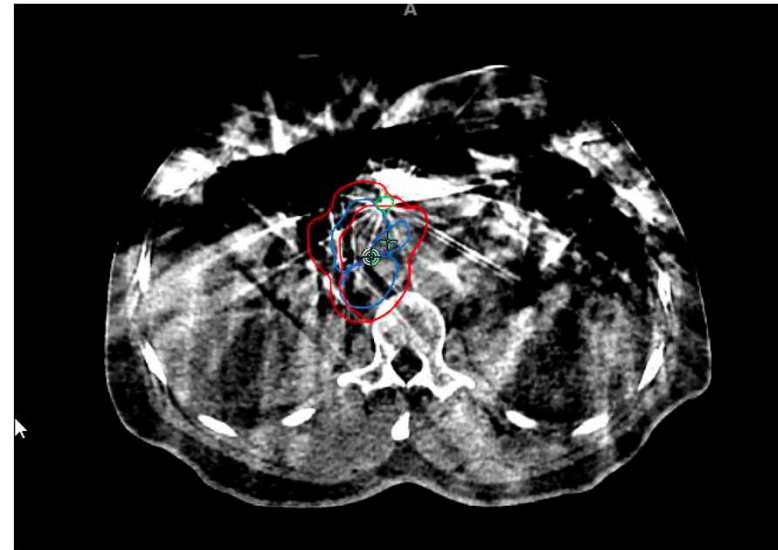
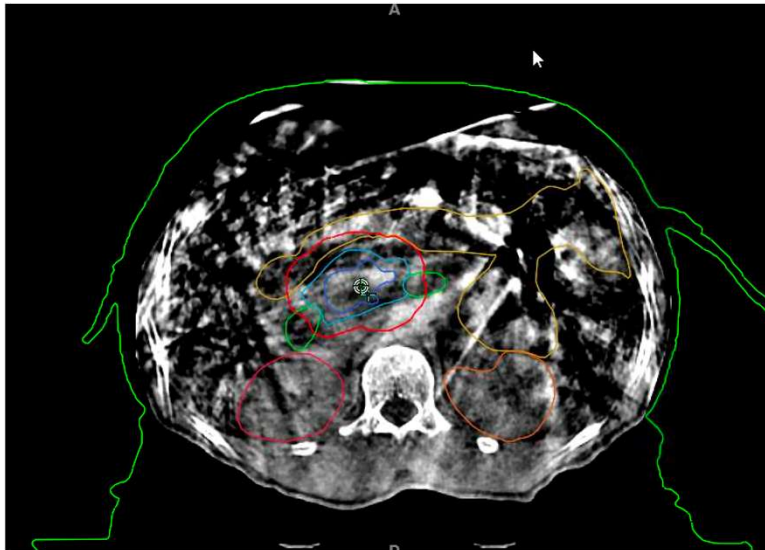
- **Fully RTT-based** —> 10 RTT trained - 2 in training
- Treatment slots : 24min (30 min 1st fraction)
  1. Face mask
  2. Patient set-up
  3. Pre-oxygenation  $\text{FiO}_2$  60% : 3-4 minutes
  4. CBCT —> IGRT (medical check for SABR)
  5. Manual delivery of beams
  6. Intra-fraction CBCT (2)—> check reproducibility
  7. (Post-delivery CBCT (3)—> check reproducibility)



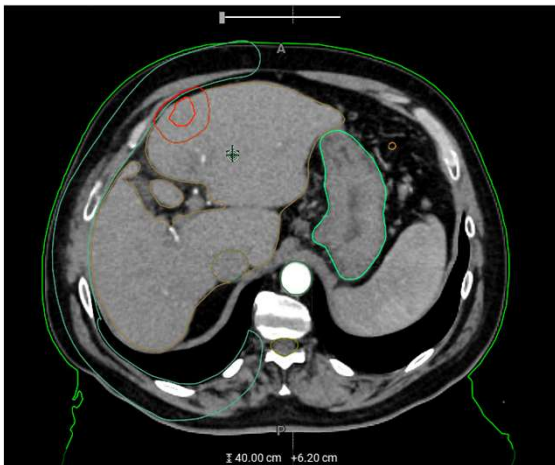




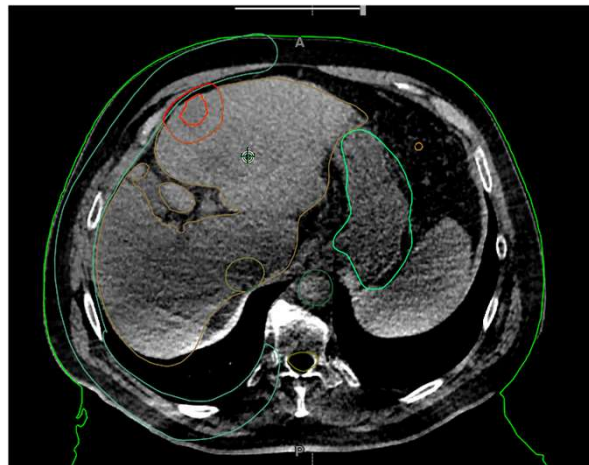
# « Trick or Treat? »



# « *Treat what you see* -Effect »



Planning CT



CBCT 1 (IGRT)

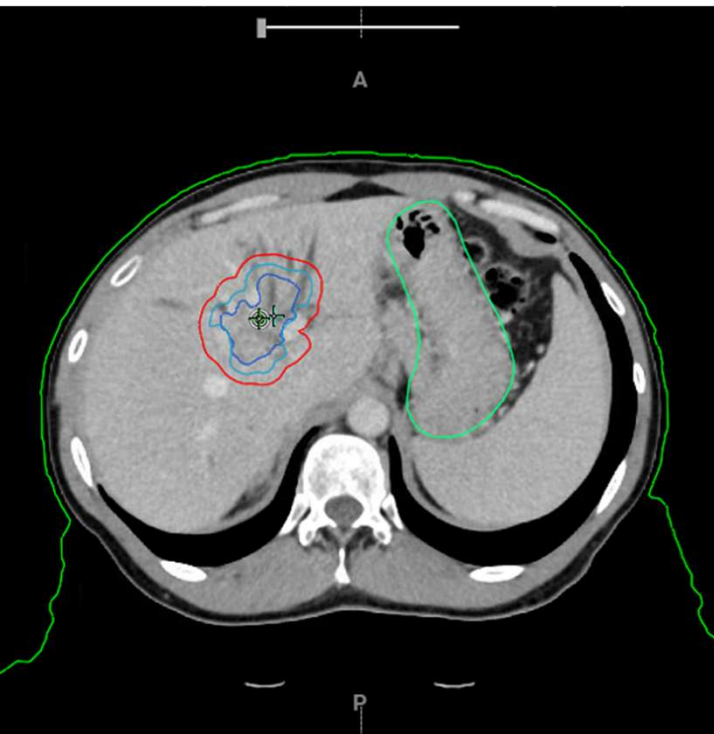


CBCT 2 (intra-fraction)

M, 37y, Cholangiocarcinoma

Treatment Date: Thursday, 10 July 2025

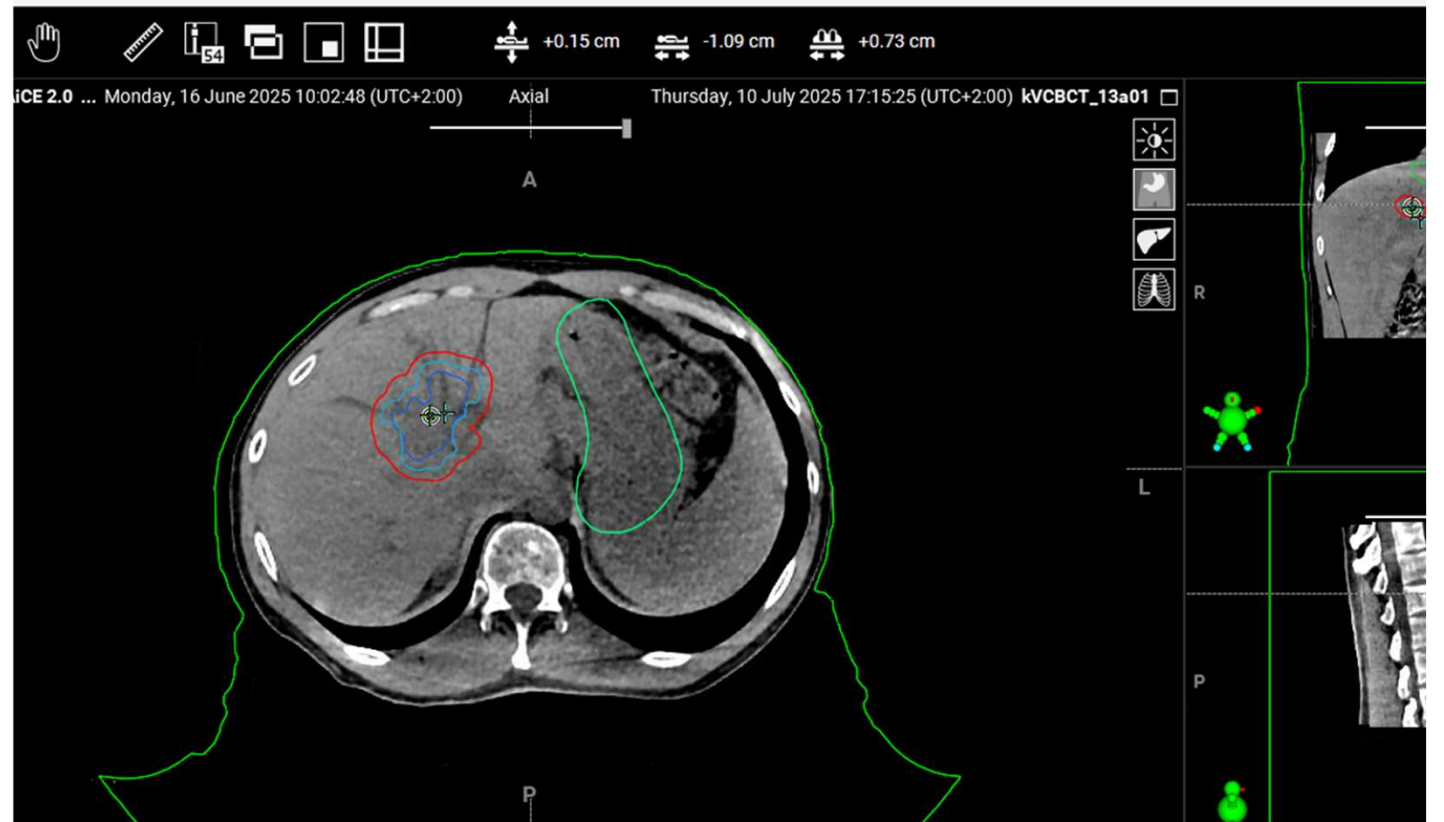
17:04:41 (UTC+2:00) | 18 min 0 sec | 17:22:41 (UTC+2:00)



Planning CT

ICE 2.0 ... Monday, 16 June 2025 10:02:48 (UTC+2:00) Axial Thursday, 10 July 2025 17:15:25 (UTC+2:00) kVCBCT\_13a01

+0.15 cm -1.09 cm +0.73 cm



CBCT - IGRT

F, 79y, pancreatic adenocarcinoma - SABR



Planning CT



CBCT



CBCT

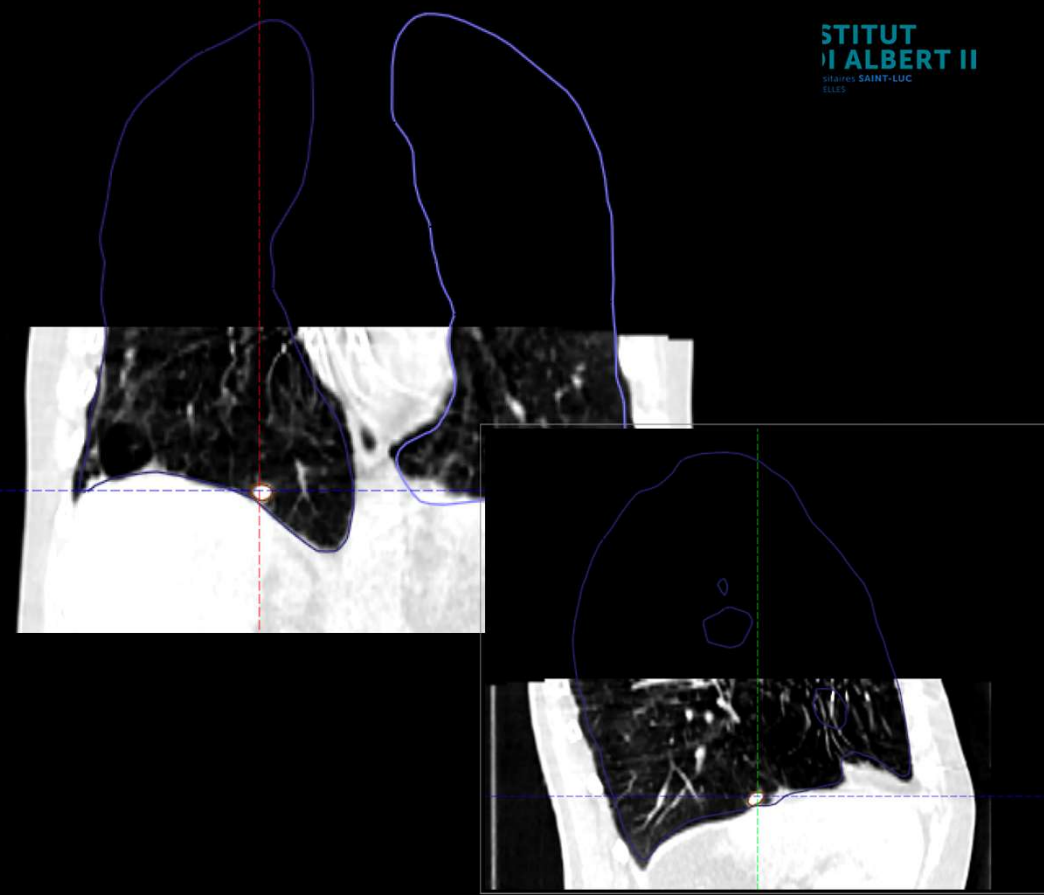
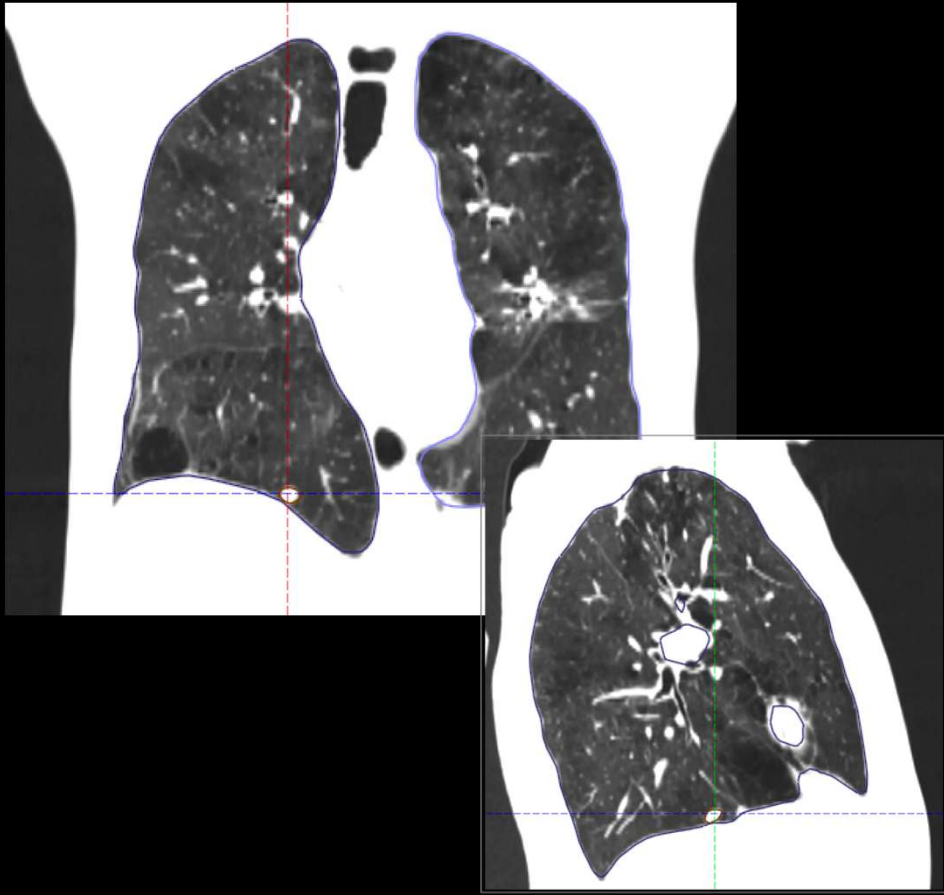


Planning CT



Central tumour

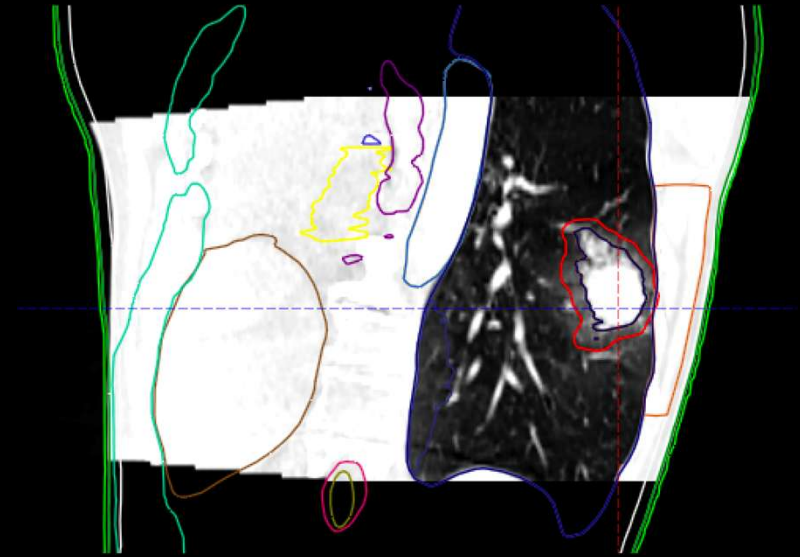
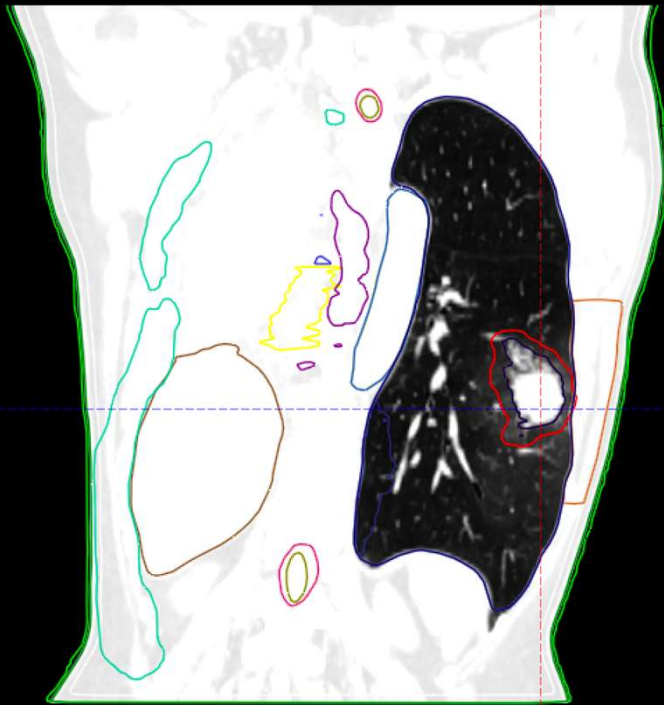
CBCT



Caudal tumour

Planning CT

CBCT



CORONAL view  
single lung remaining

Planning CT

CBCT

## Follow up

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- No dedicated follow up required
- Usual Follow up visits

## MANIV-DIBH results

- Since December 2023
- **125 patients treated** : 50% Liver, 20% Pancreas, 20% lungs
- Age : [10 - 92] years old
- Severe comorbidities
  - 3 lung fibrosis
- multi-language application
  - 1 Turkish-speaking patient « Nefes al tut »
  - 2 arabic-speaking patients
  - 1 Romanian-speaking patient
  - 3 English-speaking patients



# MANIV-DIBH results

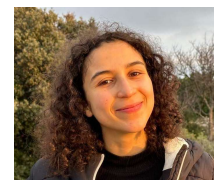
- Coaching
- 10 min is enough
  - 3 coaching interruptions for claustrophobia —> Face masks

- Delineation
- PTV margin : 5mm
  - ! posterior sulcus lower lobes : 8mm

- Delivery
- 1 treatment interruption Day 1 for dys-synchrony —> 4DCT
  - Patients survey : > 80% satisfied

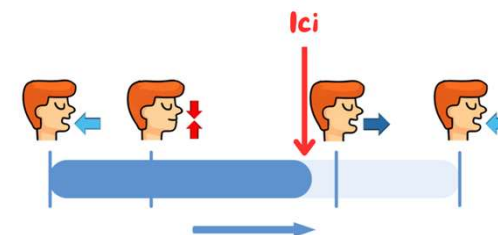
- Toxicity
- No MANIV-induced toxicity
  - Usual side effects (Fatigue)

Residual  
intra-fraction motion    ✓ 5mm    \*\*\*\*\* *Alicia Hidoud - proffered papers* \*\*\*\*\*



# MANIV-DIBH perspectives

- **ManiView**
  - Audio and visual guide for patients during their MANIV-DIBH
  - ✓ first patient test —> *go live in May?*
- *Online adaptive RT*
  - *Image quality —> AI-autosegmentation*
  - *CT-based >> MR expensive and long treatment times*
- *Severe lungs comorbidities*
  - *Expert panel discussions —> clinical feasibility trial*
- *MANIV-DIBH « optimum »*
  - *Anxiety*
  - *Duration*



In 2028?



**MANIV-DIBH**

**in routine Radiotherapy practice :**

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*A multi-centric experience?*

*Thank  
you!*



Nicolas AUDAG  
Alicia HIDOUD  
Geneviève VAN OOTEGHEM

[genevieve.vanooteghem@saintluc.uclouvain.be](mailto:genevieve.vanooteghem@saintluc.uclouvain.be)

Feel free to come along  
and visit us in Brussels !

Membre du réseau  
Lid van het netwer

