

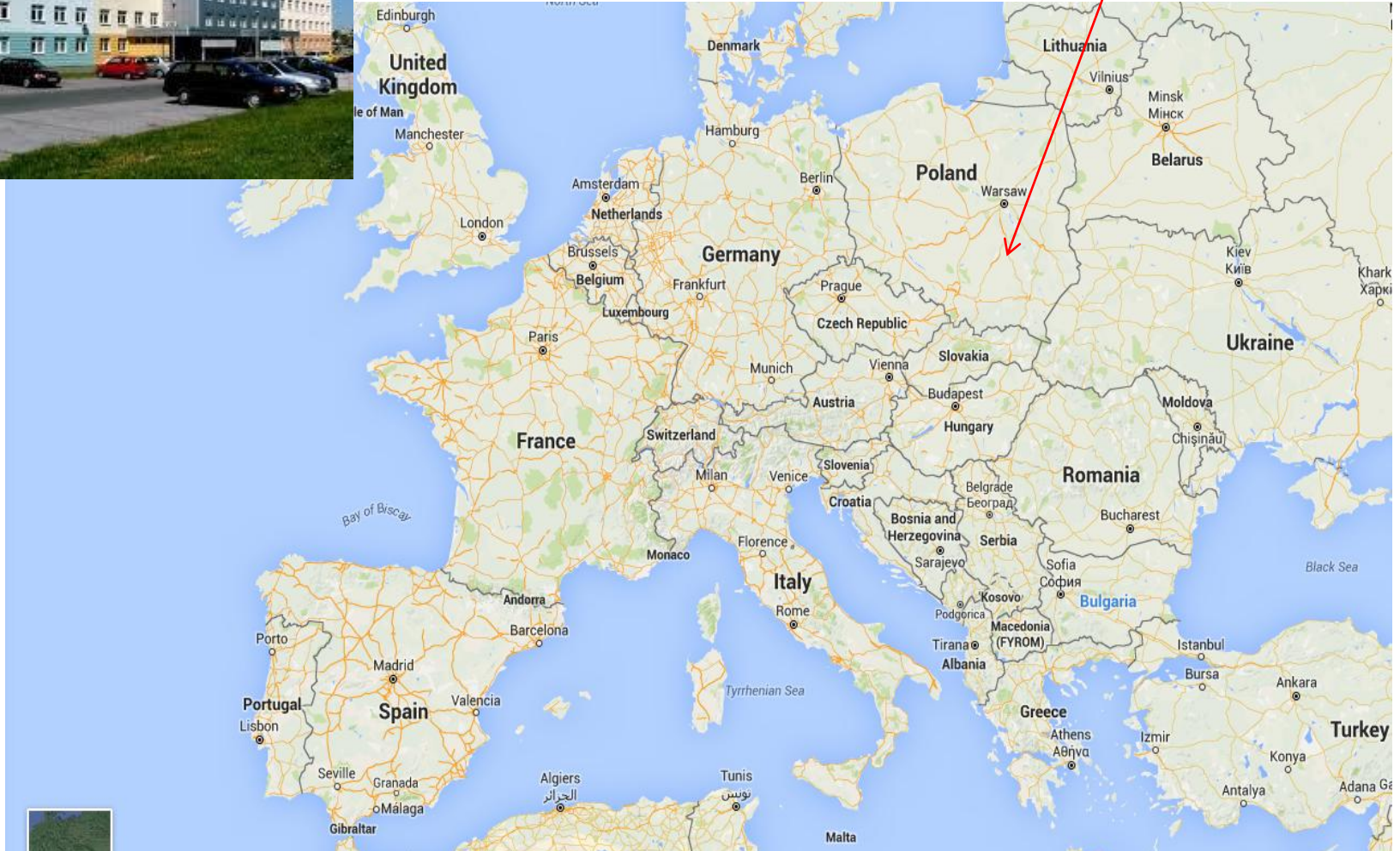
An Assessment of Linear Accelerator Productivity

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- 4 Siemens linacs: 3 Artiste+1 Oncor
 - 28 RTTs
 - 2100 patients a year (2014)



More patients = acceleration of the process = more errors

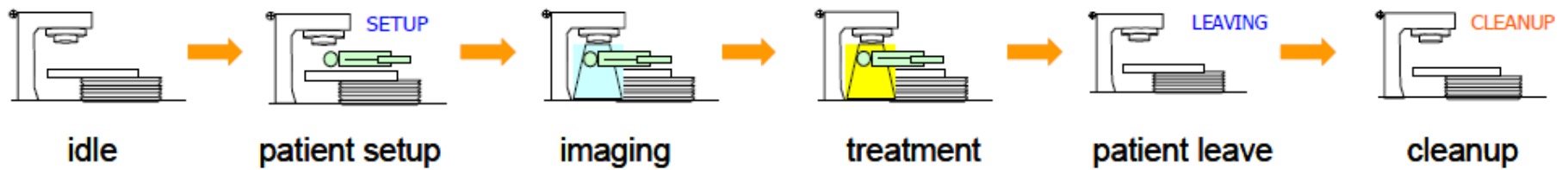


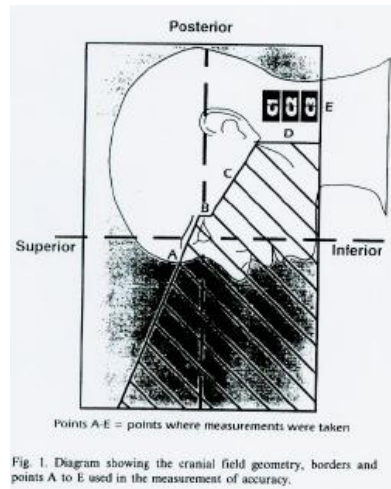
Figure 1: Steps in an RT treatment session.

- inaccuracy
- failures
- decreasing patient satisfaction

Probst H., Griffiths S.,

Increasing the work speed of radiographers: the effect on the accuracy of a set-up of a complex shaped cranial field, part of a matched cranio spinal junction, Radiotherapy and Oncology, Vol. 38, No 3, str. 241-245, 1996

- Increased speed group – **46%** of the total errors (A+B+C+D+E) were over 20mm
- Normal speed group - **18%** of the total errors (A+B+C+D+E) were over 20mm
- Set-up took **2minutes** longer in normal speed group



Productivity measures

- Fields per hour
- Patients per hour
- Basic treatment equivalent

Basic Treatment Equivalent Model 2003

(An Assessment of Linear Accelerator Throughput in New South Wales in 2003 , Delaney G., et al., 2004)

$$R = 6.71 + 3.28F + 2.39J1 + 3.21J2 + 3.19P + 2.07E + 1.96N + 1.94Bo - 0.74M1 - 2.44M2 - 3.05M3 - 2.42Au$$

Where R = Predicted treatment time in minutes; F = First fraction (1 if yes; 0 otherwise); J1 = 1-2 junctions (1 if number of junctions 1 to 2, 0 otherwise); J2=3+ junctions (1 if number of junctions 3 or more, 0 otherwise); P = Number of port films taken; E = Number of EPI images taken; N = Number of fields; Bo = Bolus used (1 if bolus given, 0 otherwise); M1 = Use of MLC in 1-3 fields (1 if MLC used in 1-3 field, 0 otherwise); M2 = Use of MLC in 4-6 fields (1 if MLC used in 4-6 fields, 0 otherwise); M3 = Use of MLC in 7 or more fields (1 if MLC used in 7 or more fields, 0 otherwise); Au = Use of auto-sequencing (1 if auto-sequencing used, 0 otherwise).

For example

- Prostate cancer – 6 beams

$$R=6,71+3,28 \cdot 1+2,07 \cdot 6+1,96 \cdot 6-2,44 \cdot 1-2,42 \cdot 1=29,31\text{min,}$$

2,9 BTE

-first fraction: 29,31 min

-next fraction: 13,61min

It's necessary to improve BTE model

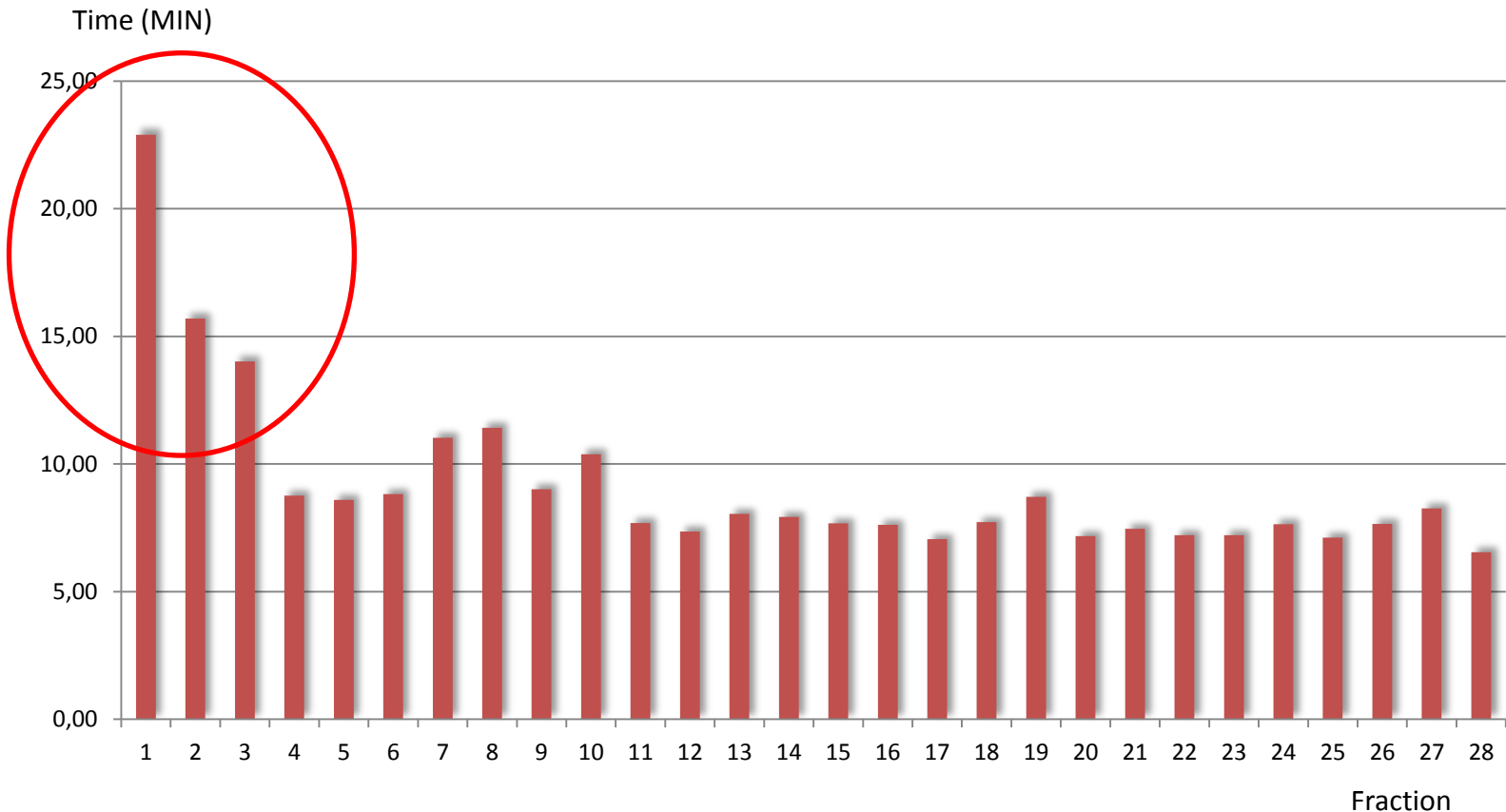
- Newer technology
- IGRT
- In-vivo
- Experience of the RTTs
- Unforeseen delays
- Teaching activities

Materials and methods

- 11 patients treated in pelvic region
- 299 fractions
- fraction duration was defined as the time when the patient entered the room until the time the patient left the room
- the radiation therapists used a stopwatch to measure the duration of every treatment fraction

Results

- Medium time of one fraction– 9,38min
- Medium time of patient setup - 1,55min



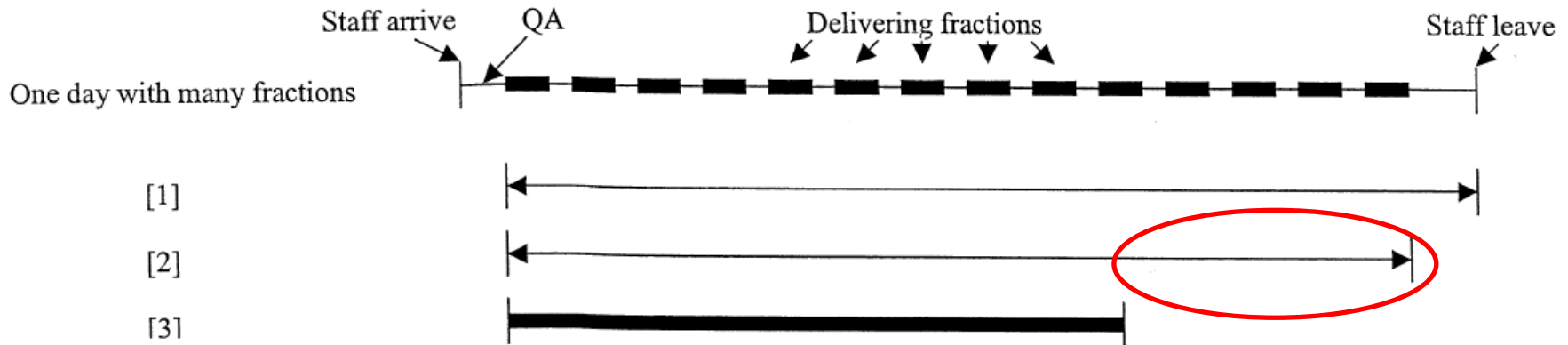
Results

The most influential predictors of fraction durations are:

- Set-up verification
 - Procedures
 - Technical problems with application
 - Results out of tolerance – repeat of setup and procedure
- Unforeseen linac failures
- Waiting for the doctor and his decision
- Organisational aspects (cooperation, information)

What can we improve?

- training
- work organisation - workflow
- optimization of unused time between fractions



[1] Potential operational time: time where the unit is staffed and QA has been completed. [2] Operational time: time between start of first fraction of the day to the end of the last fraction of the day. [3] On time: time the unit is actually delivering RT, does not count time between fractions. [4] Unused potential operational time: Potential operational time [1] - Operational time [2]. [5] Sum of time between fractions: Operational time [2] - On time [3].

Thank you for your attention