# The Contribution of Skin Contamination Dose to the Total Extremity Dose of Nuclear Medicine Staff: First Results of an Intensive Survey

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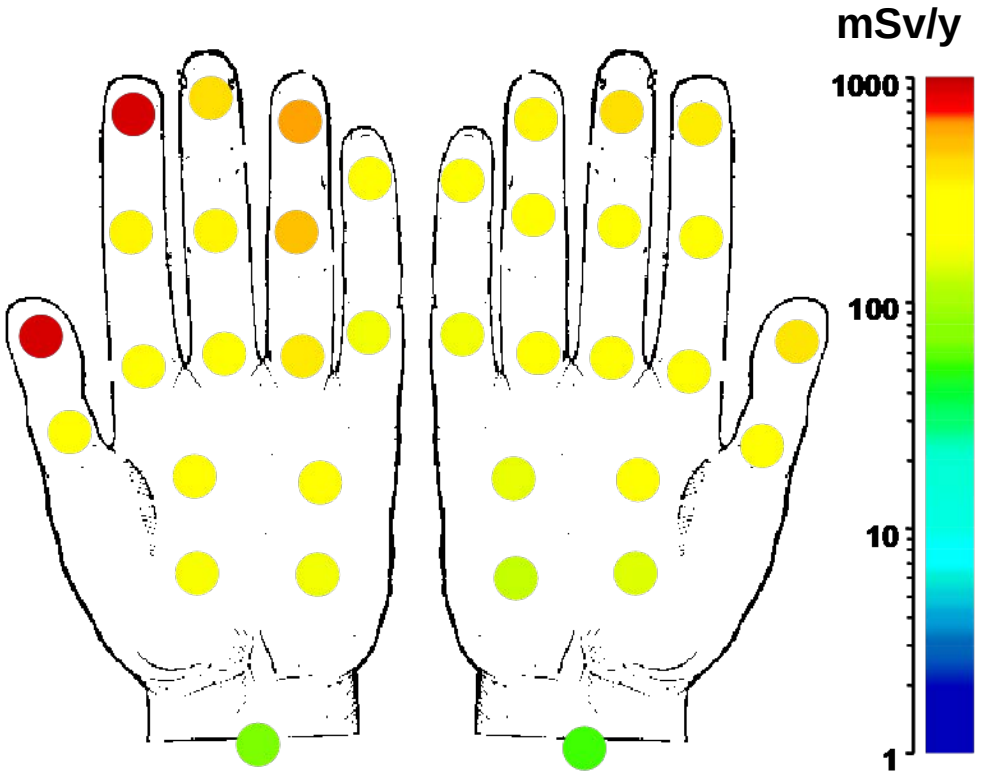
# Introduction

## Manipulation syringes and vials in Nuclear Medicine

- Relatively high dose rates to hands
- Not uniformly distributed
- Annual dose limit easily exceeded at high workload



# Contaminations?

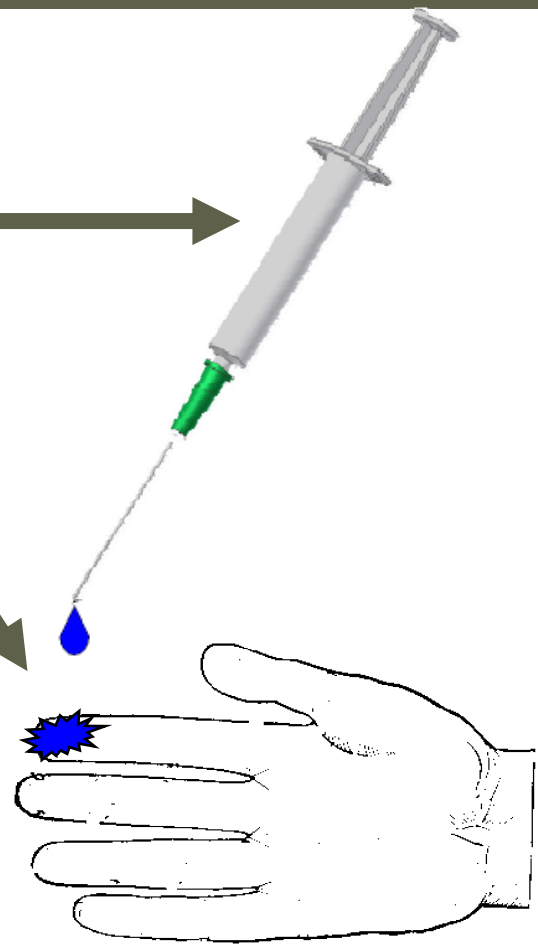
## High doses can be expected

2ml-syringe with typical reference activity for common diagnostic procedure

20µl spot, 15 min exposure time

| Cumulated skin dose | |
|---|---|
| $^{99m}$Tc | 15 mSv |
| $^{18}$F | 500 mSv ! |

Delacroix et al.



## Dose from “sealed” manipulations: tip of iceberg?

# Origin of contaminations

## Directly

- Spills
- Removing needles/catheters
- Compress pressing
- Body fluid of patients

## Cross contamination

- Contaminated surfaces
- Contaminated tools / protection equipment

# Detection and quantification of contaminations

Contamination check by workers

- Time consuming, asks for self-discipline
- Short half-life radionuclides → late detection difficult
- Difficult to quantify with common contamination monitors

On-site survey needed

Survey started, protocol based on on-site detection/localisation/quantification

# Methodology/Protocol (1)

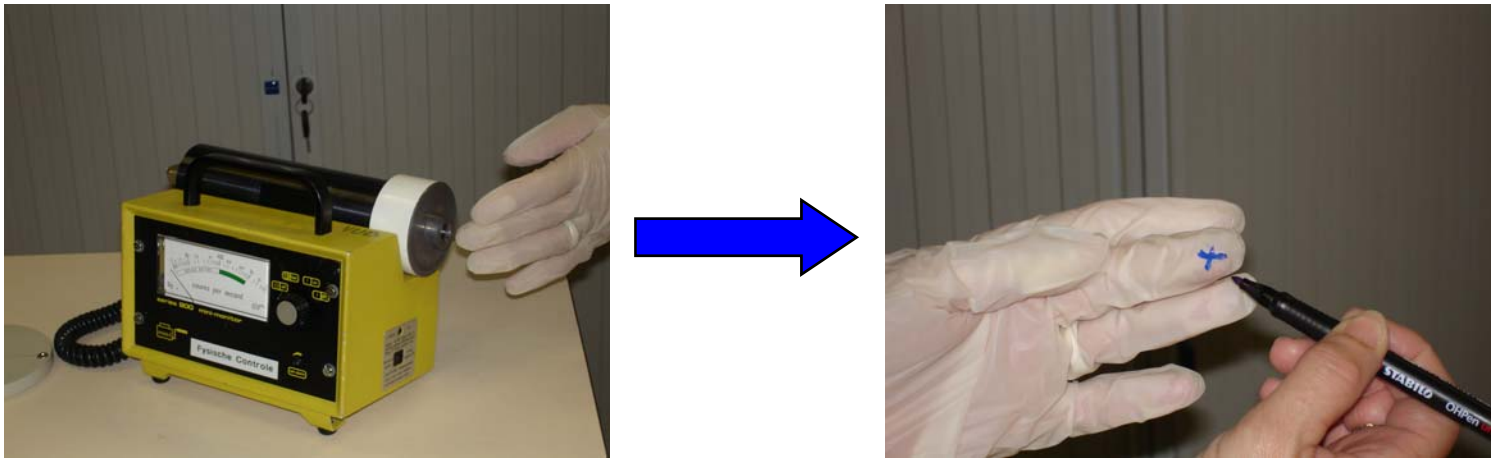
## Contamination detection

- On site survey during working day
- NaI-contamination monitor

# Methodology/Protocol (2)

## Contamination localisation

- Protective glove over contamination
- NaI-contamination monitor, small 1cm$^2$-collimator
- Marking location



# Methodology/Protocol (3)

## Calibrated Gamma Spectrometer

- NaI Probe mounted in large 1cm$^2$-collimator
- Probe adjustable in height (equilibrium between dead time and sufficient count rate)
- 3 spectra acquired during 60s (repositioning finger)
- Decontaminate and recount

# Methodology/Protocol (4)

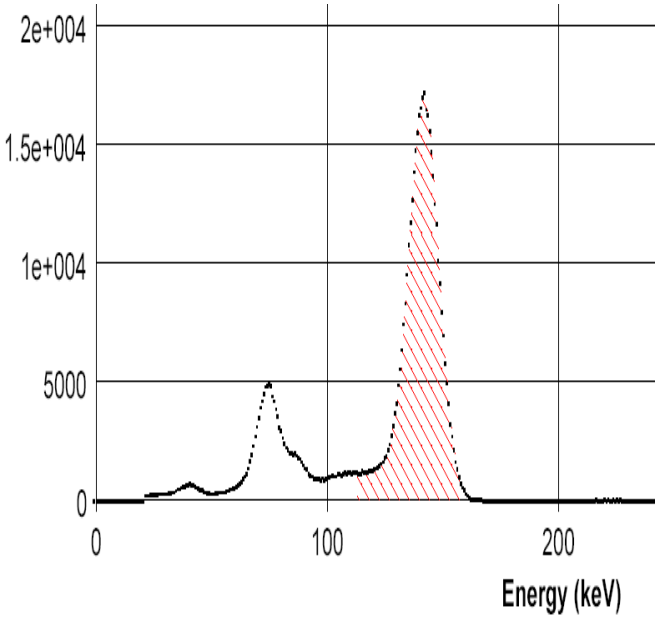
## Spectrum Analysis

- Nuclide identification
- Activity calculation averaged over 1cm$^2$

## Calculation of dose rate and cumulated dose

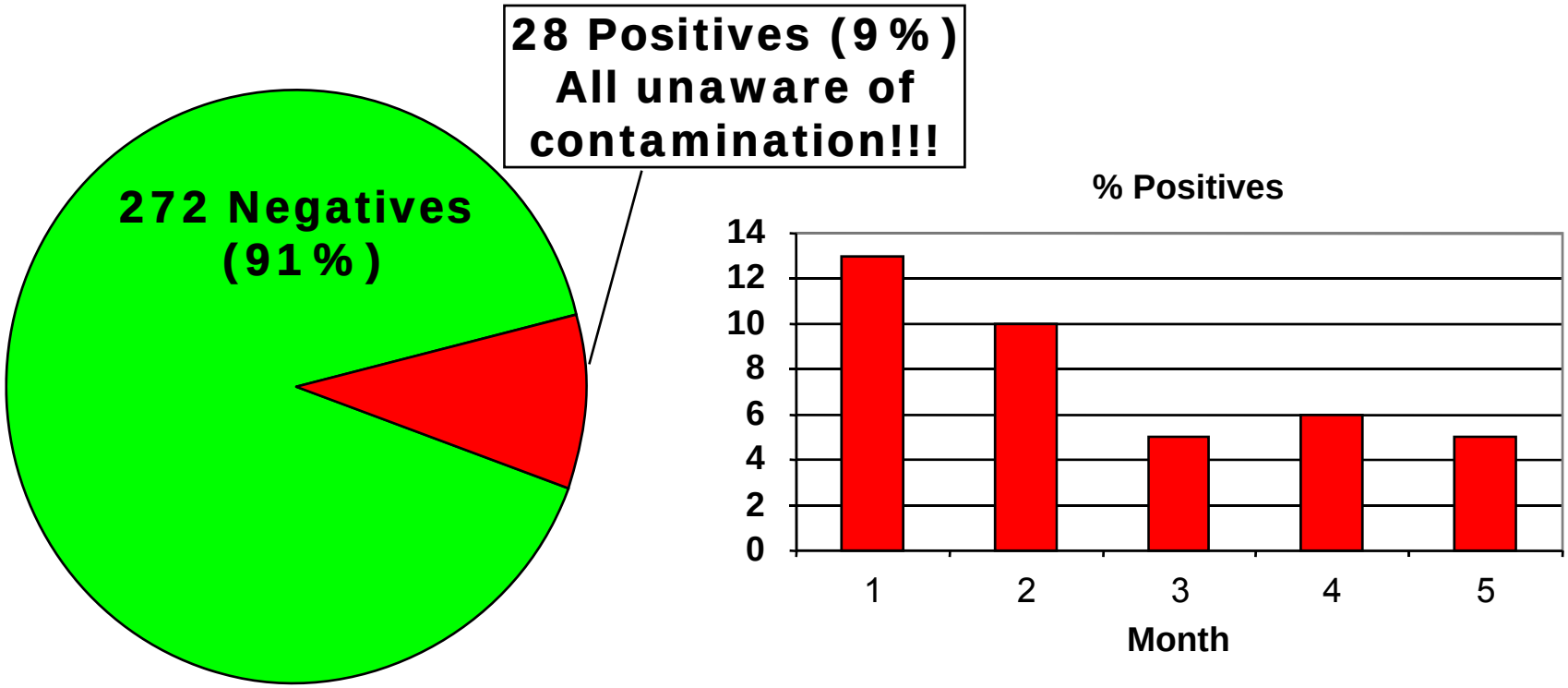
(3 ref. data)

- Delacroix et al.
- Varskin 3
- MCNP$_{\text{Lara Struelens}}$



# Results: Incidence

5 months survey, 30 days, 300 inspections, 10 workers



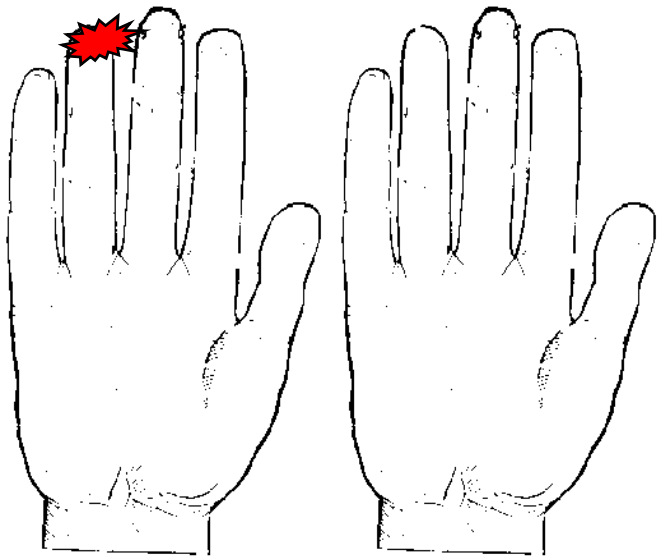
# Results: Nature of contamination

Not uniform deposits but local contaminations! (90% cases)

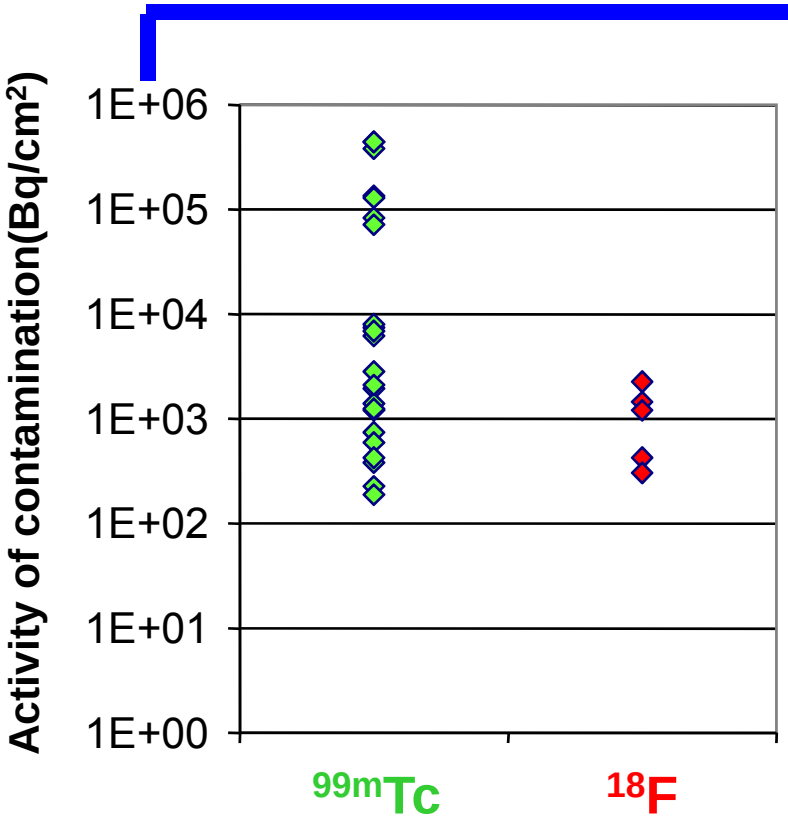
Mostly index tip of non dominant hand (70% cases)

Out of 28 positives:

- 23 $^{99m}$Tc-radiopharmaceuticals
- 5 $^{18}$FDG



# Results: Order of magnitude




| Hp(0.07), contamination 1cm² (mSv/h/kBq) | | |
|---|---|---|
| | $^{99m}$Tc | $^{18}$F |
| Delacroix et al. | 8.77E-3 | 7.88E-1 |
| Varskin 3 | 5.78E-3 | 1.76E+0 |
| MCNP$_{\text{Lara Struelens}}$ | 3.85E-3 | 1.37E+0 |

# Factors in calculation of cumulated skin doses

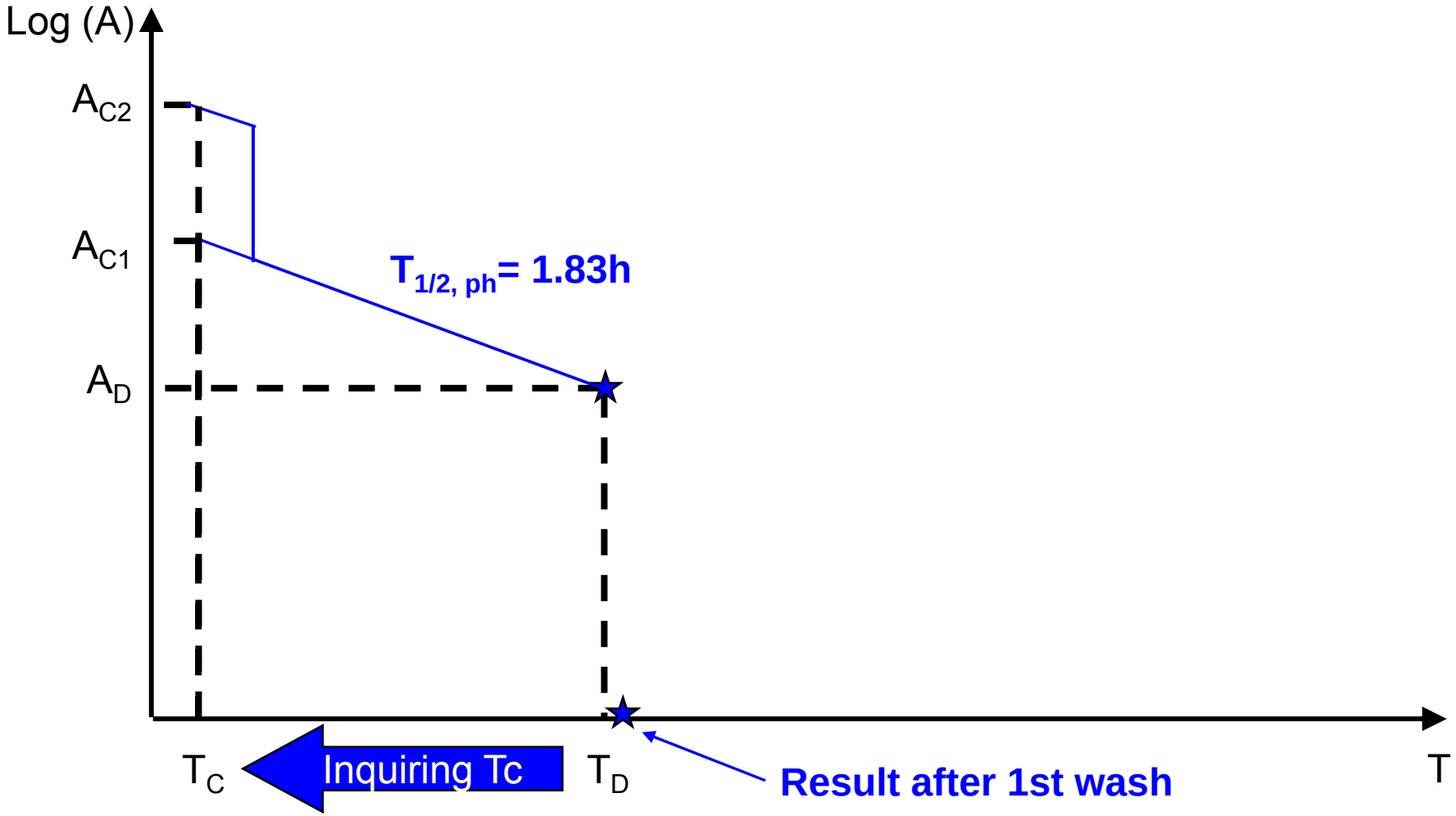
Exposure time?

- Inquiring possible time of contamination ($T_c$)
- Exposure starts from $T_c$

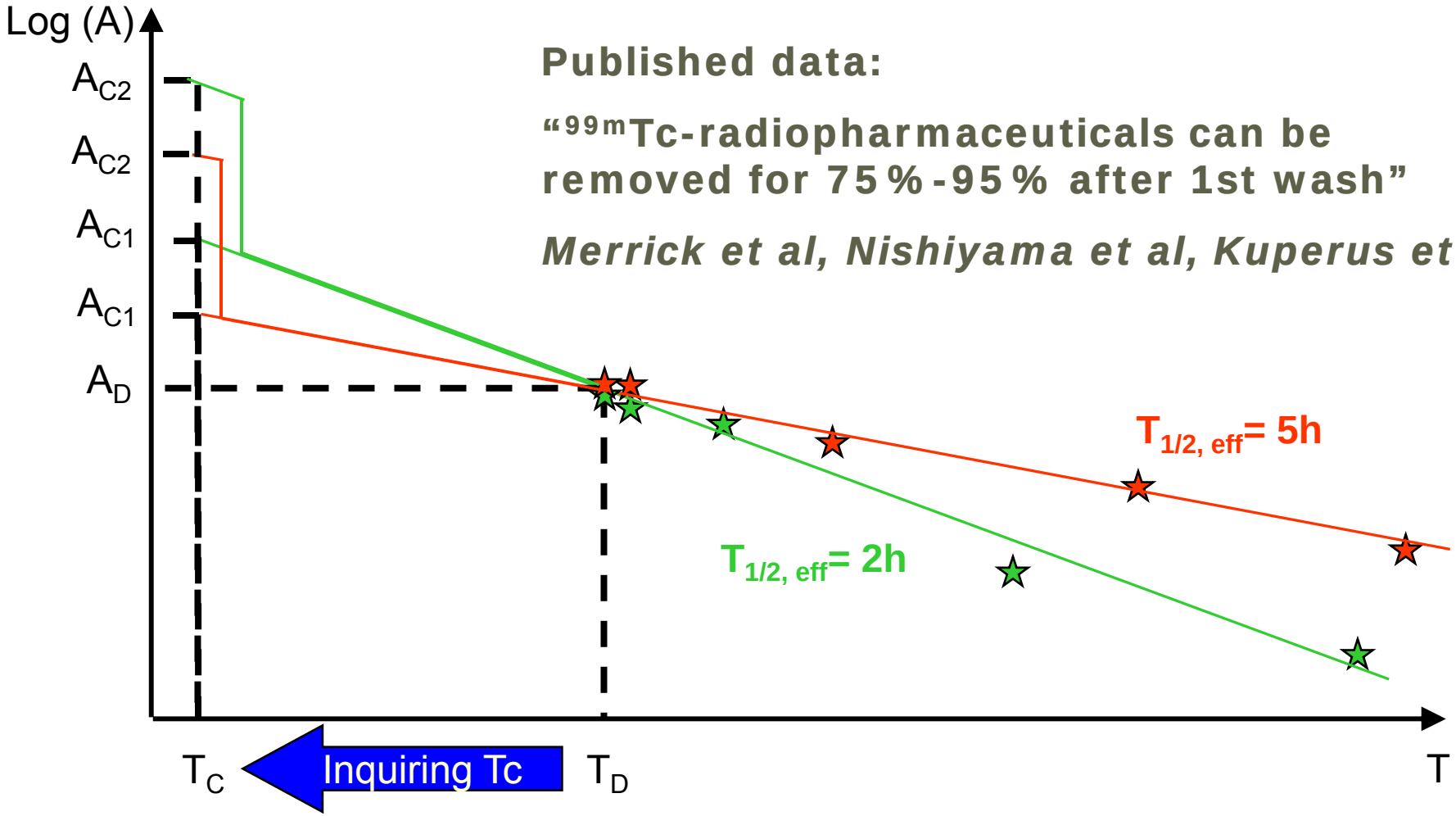
Efficiency of decontamination? $T_{1/2,eff}$?

- Determined by repeated washes and measurements of positive results
- Radiopharmaceutical-related
- $^{18}$FDG can be removed completely after 1st wash
- $^{99m}$Tc-radiopharmaceuticals difficult to remove

# Results: Decontamination of $^{18}$FDG



# Results: Decontamination of $^{99m}$Tc-radiopharmaceuticals



# Results: Calculated cumulated skin doses

Conservative assumption

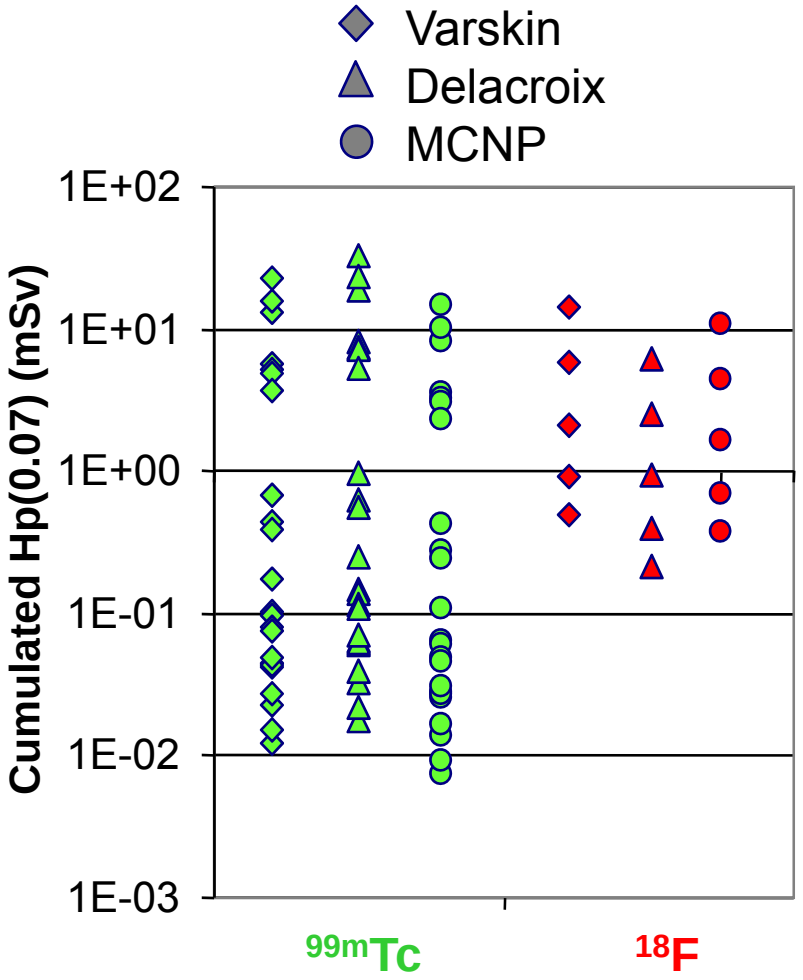
$^{99m}$Tc: $A_{C1}$, $T_C$ ,$T_{1/2,eff}$ (individual)
Exposure time: 48h

$^{18}$FDG: $A_{C1}$, $T_C$, $T_{1/2,ph}$
Exposure time $T_D$-$T_C$

For individual worker:

Values up to 30mSv can be measured due to single contamination!

> 500mSv/y based on random survey



# Next?

Refining dose rate calculations

Contamination survey will resume after 2 months break

Possibility survey in other hospital

$T_{1/2,eff}$ of radiopharmaceuticals?

- Further analysis in vivo in case of positive contamination
- New study started to determine $T_{1/2,eff}$ using pig skin samples

# Conclusions

- Contamination survey in NM
  - Positive results on a regular base
  - Enables to quantify activity/dose rate
- Calculation of cumulated dose
  - Influenced by dose rate values, $T_c$ and $T_{1/2eff}$
  - More research needed
- Possible contribution to the total extremity dose can easily exceed 500mSv/y

# Thank you for your attention!