



EXTREMITY EXPOSURE IN NUCLEAR MEDICAL THERAPY WITH Y-90 LABELLED SUBSTANCES

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ORAMED work packages WP4 “Extremity dosimetry in nuclear medicine”

OBJECTIVES

Global aim: Optimisation of radiation protection standards and individual dose monitoring of staff in nuclear medicine

Method: Evaluation of extremity exposure of nuclear medical staff and analysis of the impact of protective measures/tools such as syringe and vial shield

- | | |
|---|---|
|  Methods and general aspect |  <i>Donadille et al.</i> |
|  Measurements in diagnostics with Tc-99 and F-18 |  <i>Carnicer et al.</i> |
|  <u>Measurements in therapy procedures with Y-90</u> |  <u><i>this presentation</i></u> |
|  Results from Monte Carlo simulations |  <i>Ferrari et al.</i> |
|  Guidelines and recommendations |  <i>Sans Merce et al.</i> |

Scope of measurements in preparation (P) and administration (A) of Y-90 in NM therapies

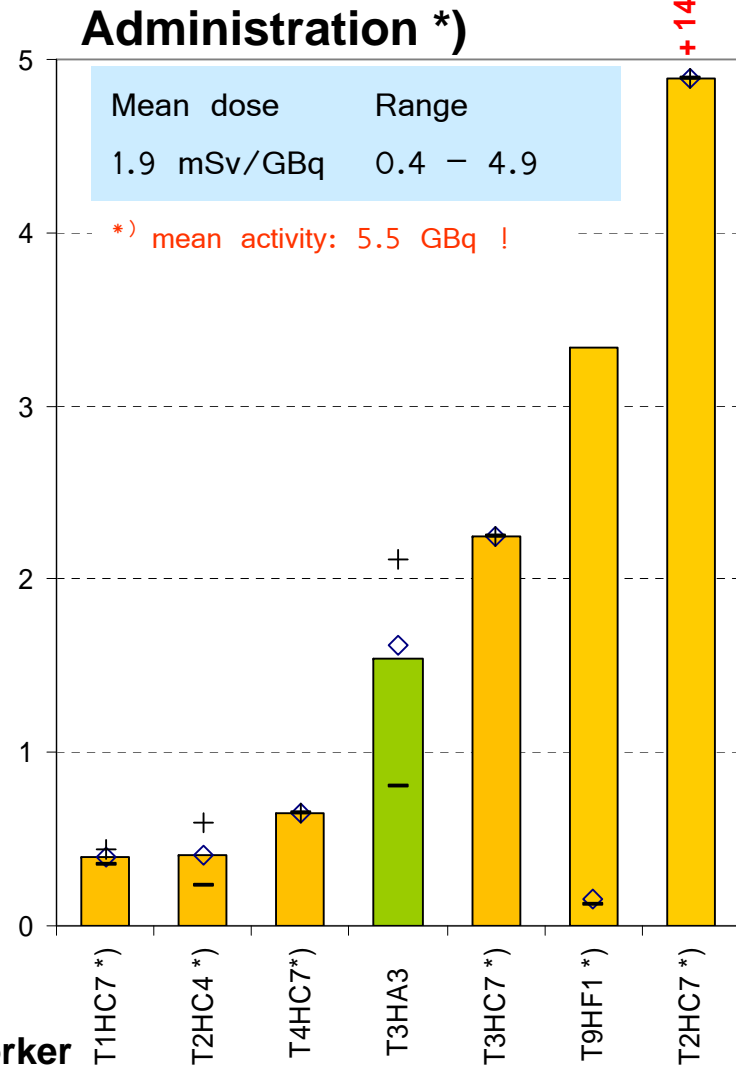
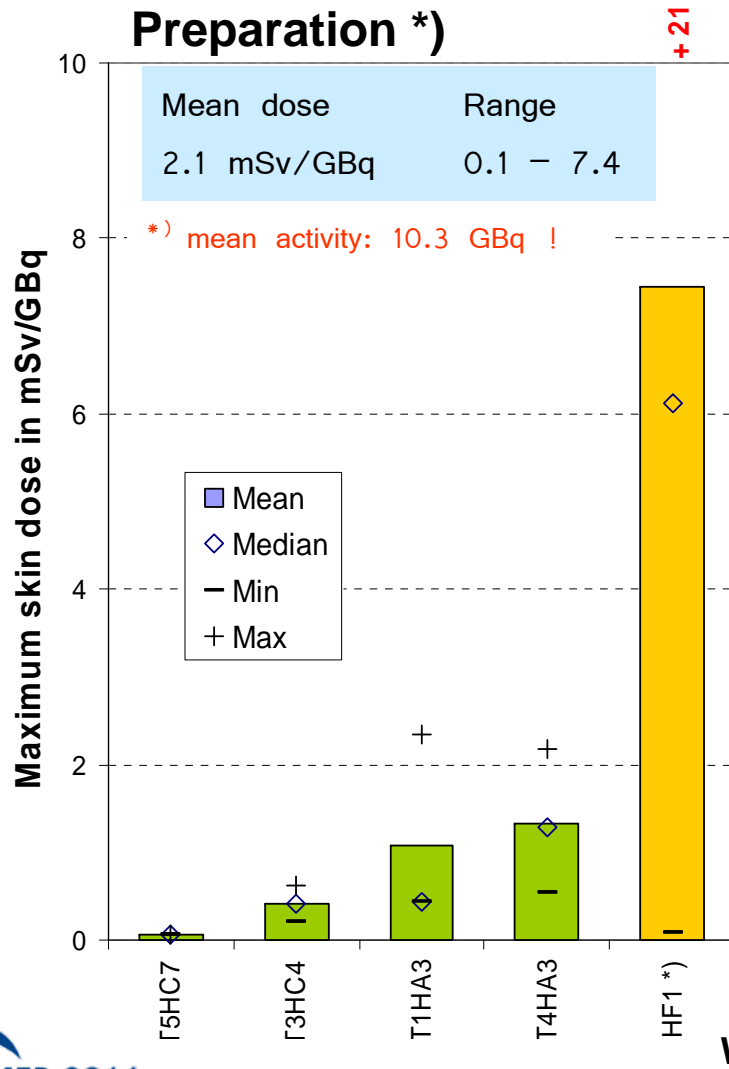
Therapy	Procedures	Number of			
		Labs	Hospitals	Workers	Data sets
SIRS	P+A	2	3	4	20
PRRT <i>Dotatoc</i>	P	3	3	5	16
	A	3	3	7	17
RIT <i>Zevalin</i> ®	P	6	16	20	49
	A	6	15	22	45



Results presented:

- PRRT: ✓ Classification of workers (not enough data for more !)
- RIT: ✓ Classification of workers (max. skin dose mean/median + range)
- ✓ 'Dose history' for subsequent measurements
- ✓ Ratio of maximum dose to dose on potential dosimeter positions

Classification of workers for PRRT with Y-90/Dotatoc



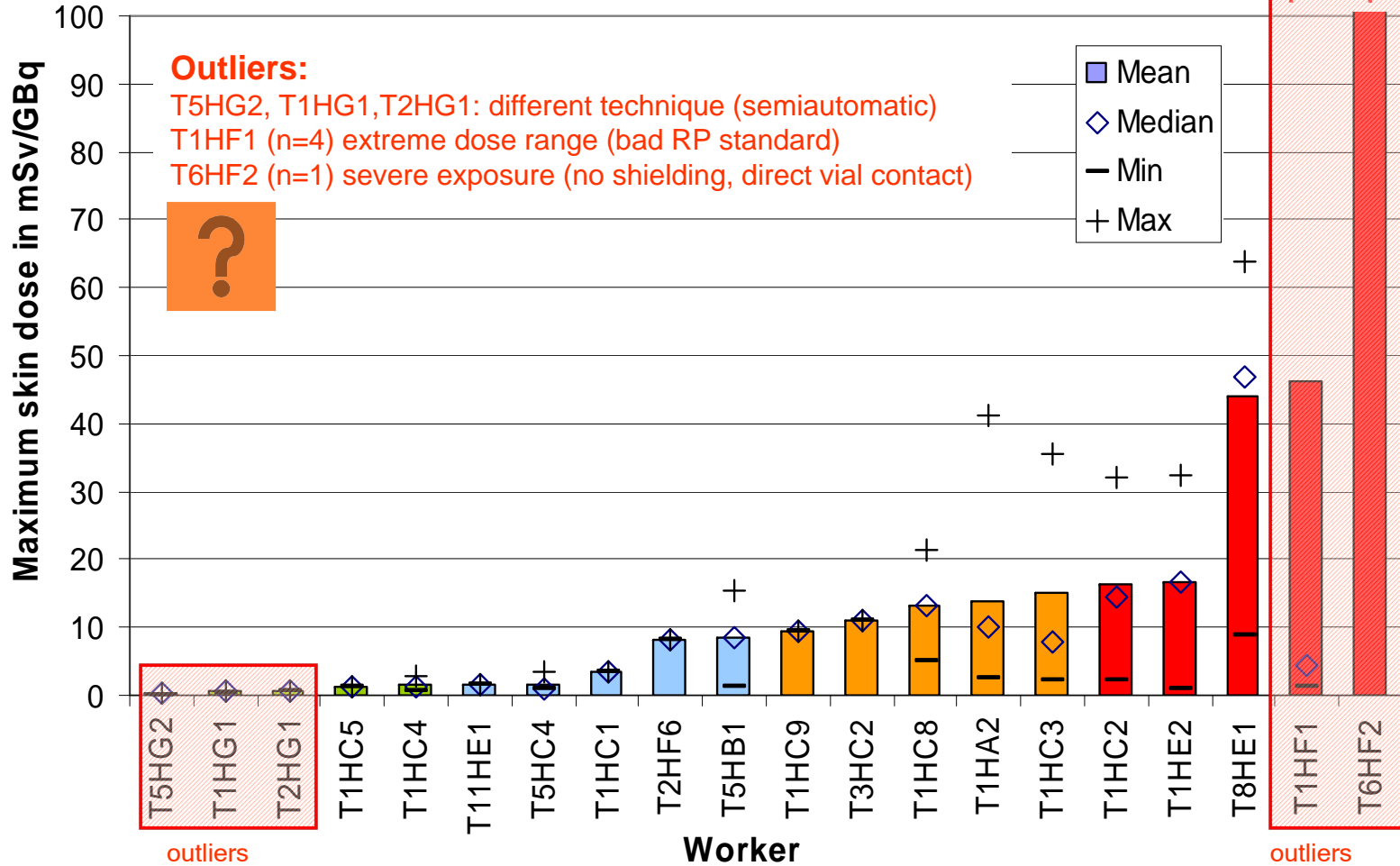
*) no shielding used (yellow)



RESULTS

Classification of workers for RIT with Y-90/Zevalin, Preparation

Maximum skin dose quartiles on both hands





RESULTS

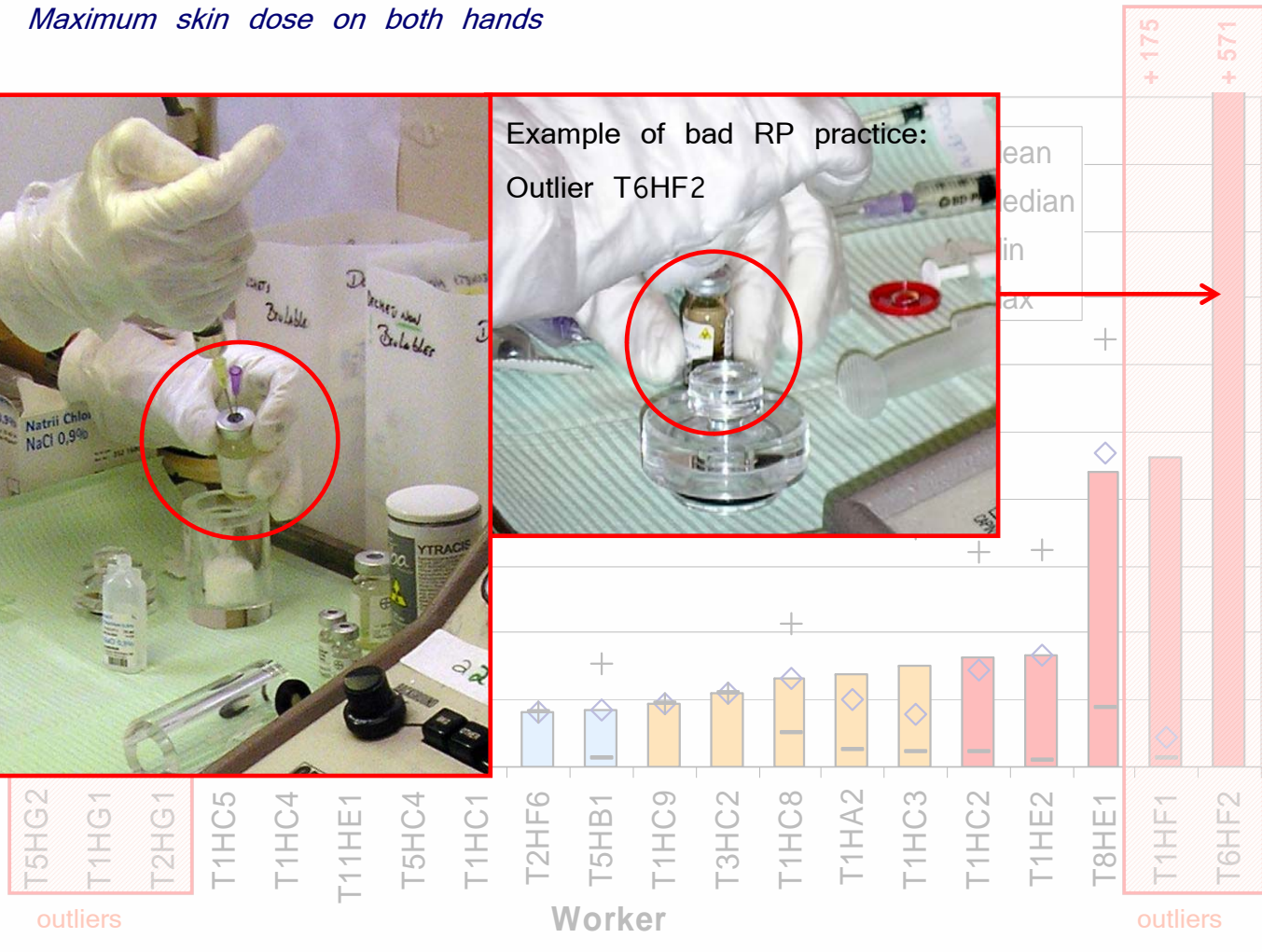
Classification of workers for RIT with Y-90/Zevalin, Preparation

Maximum skin dose on both hands

Maximum skin dose in mSv/GBq



Example of bad RP practice:
Outlier T6HF2

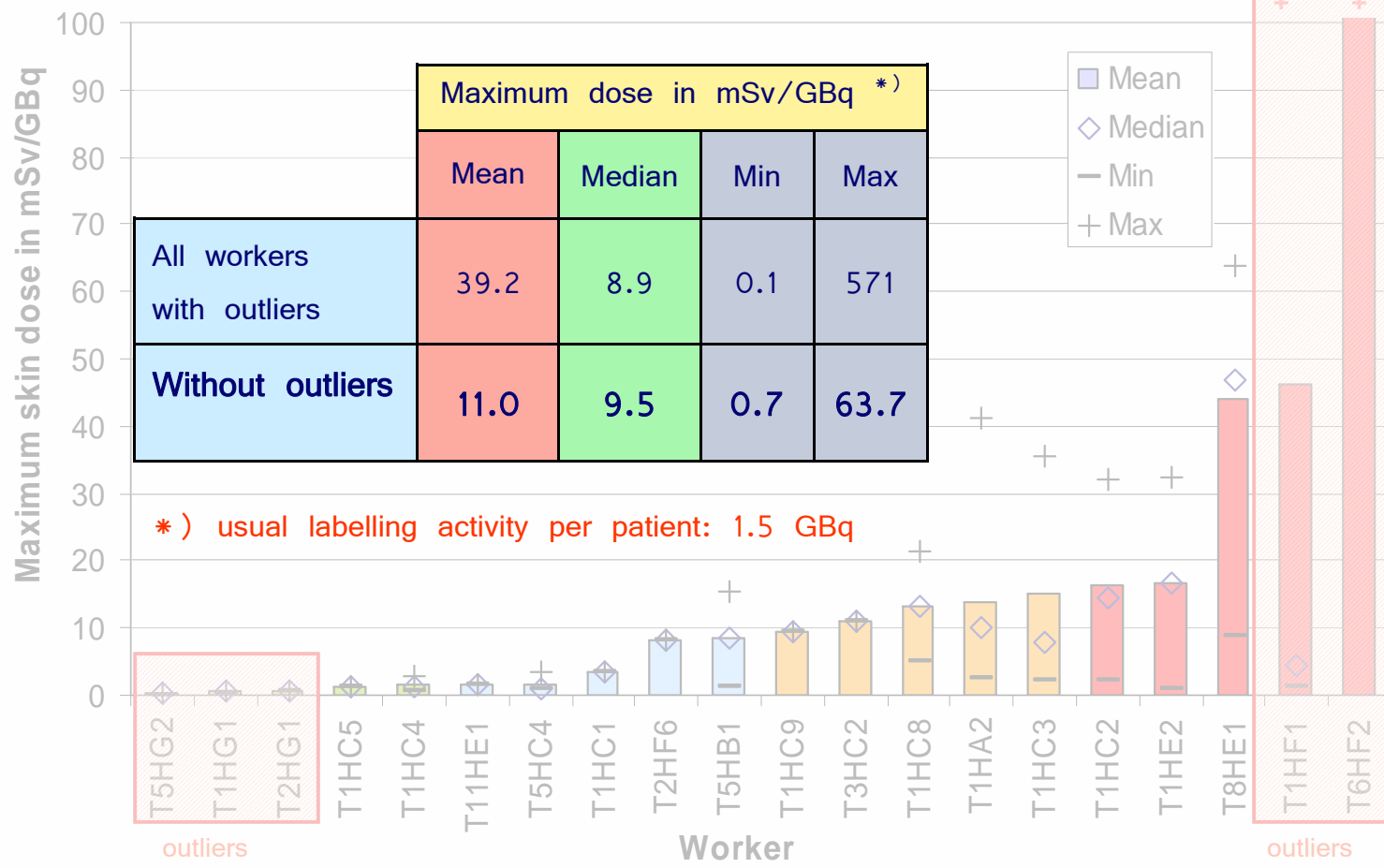




RESULTS

Classification of workers for RIT with Y-90/Zevalin, Preparation

Maximum skin dose on both hands





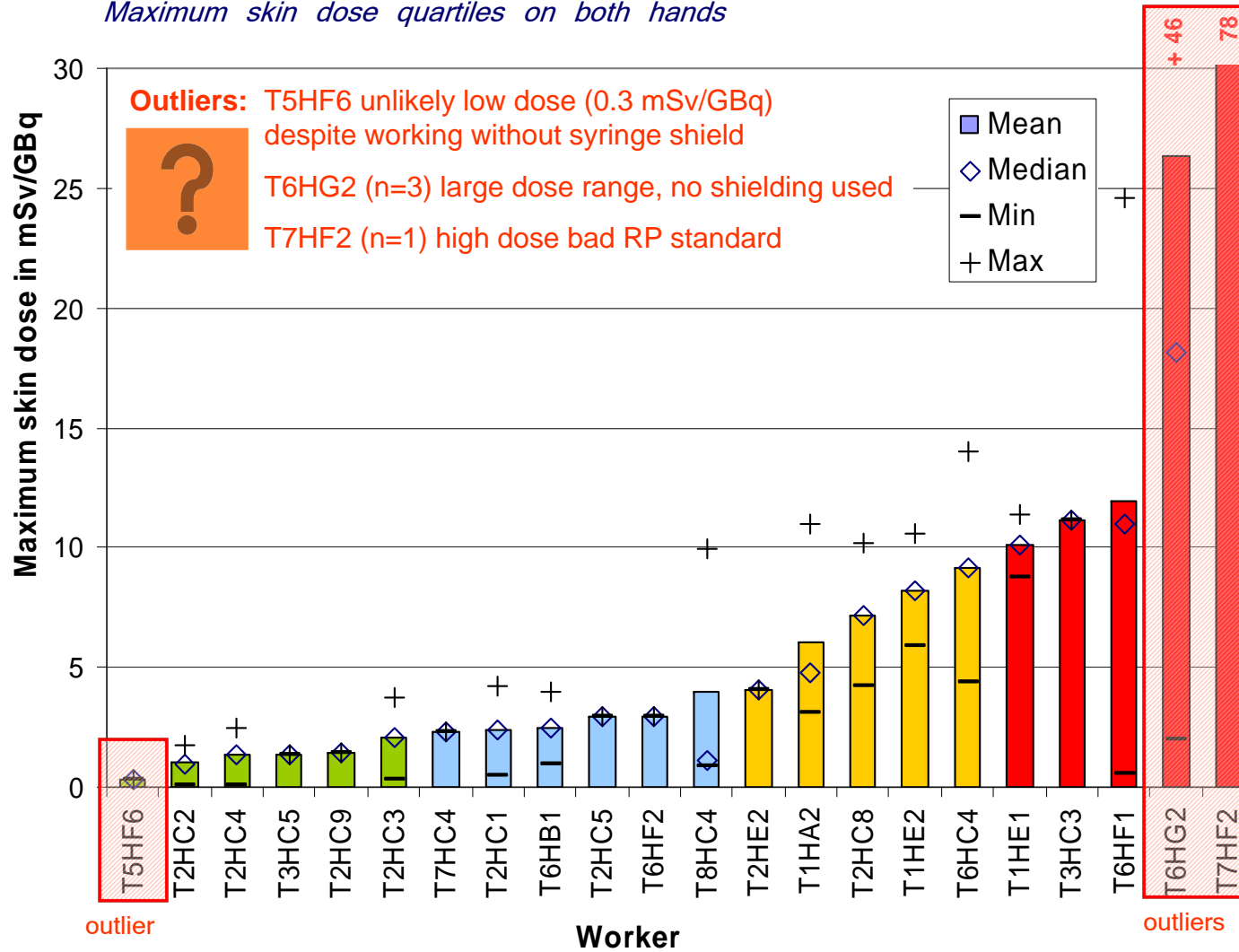
RESULTS

Maximum skin dose in Y-90/Zevalin preparation

	Maximum dose in mSv/GBq							
	Non-dominant hand				Dominant hand			
	Mean	Median	Min	Max	Mean	Median	Min	Max
All workers with outliers	37.0	7.8	0.03	571	7.6	1.7	0.1	63.7
Without outliers	8.2	8.2	0.7	41.3	6.2	1.8	0.2	63.7

- ↪ *Non-dominant hand is higher exposed than dominant hand*
- ↪ *Highest exposed positions: tip of index finger and thumb*

Classification of workers for RIT with Y-90/Zevalin, Administration
Maximum skin dose quartiles on both hands





RESULTS

Classification of workers for RIT with Y-90/Zevalin, Administration

Maximum skin dose on both hands

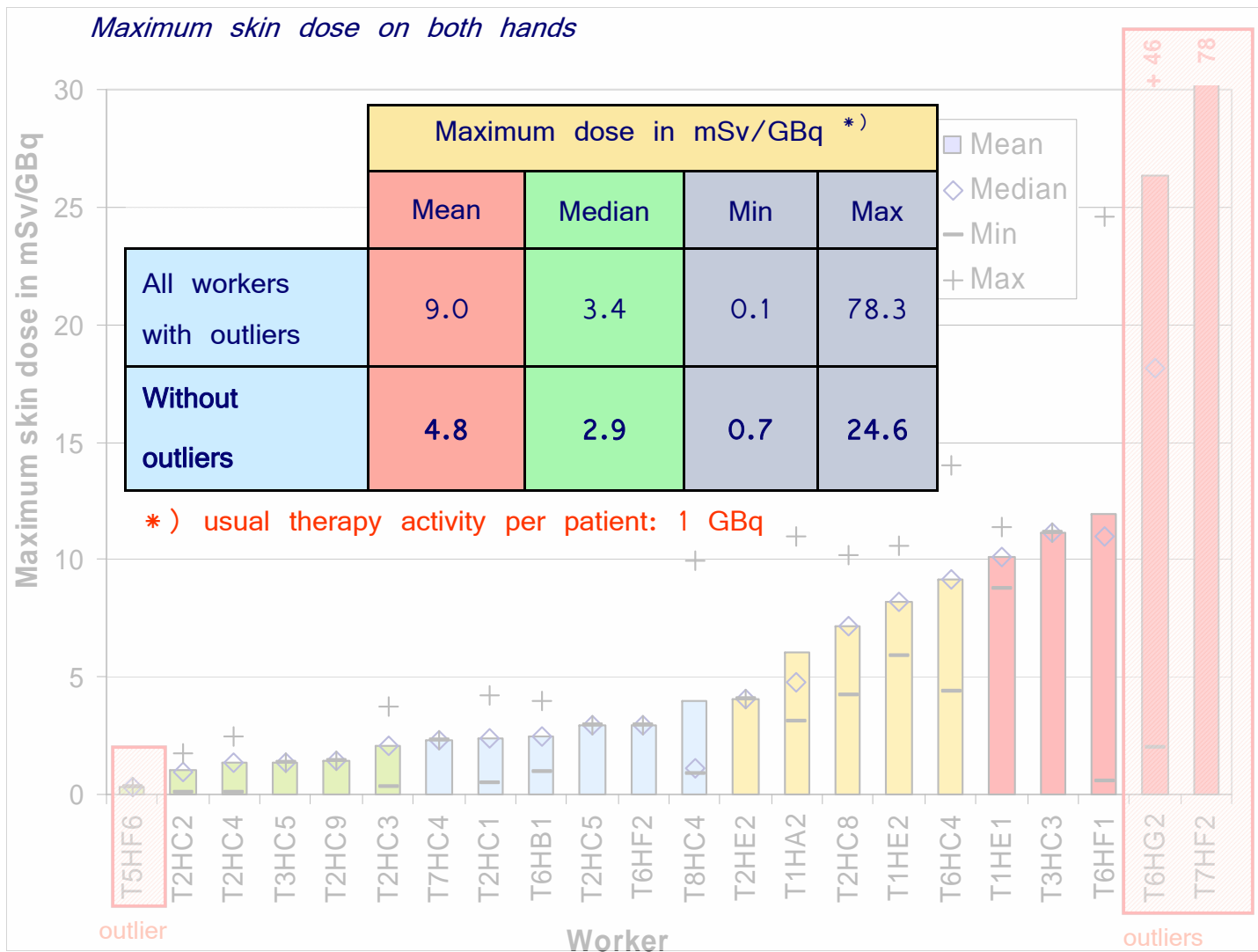




RESULTS

Classification of workers for RIT with Y-90/Zevalin, Administration

Maximum skin dose on both hands





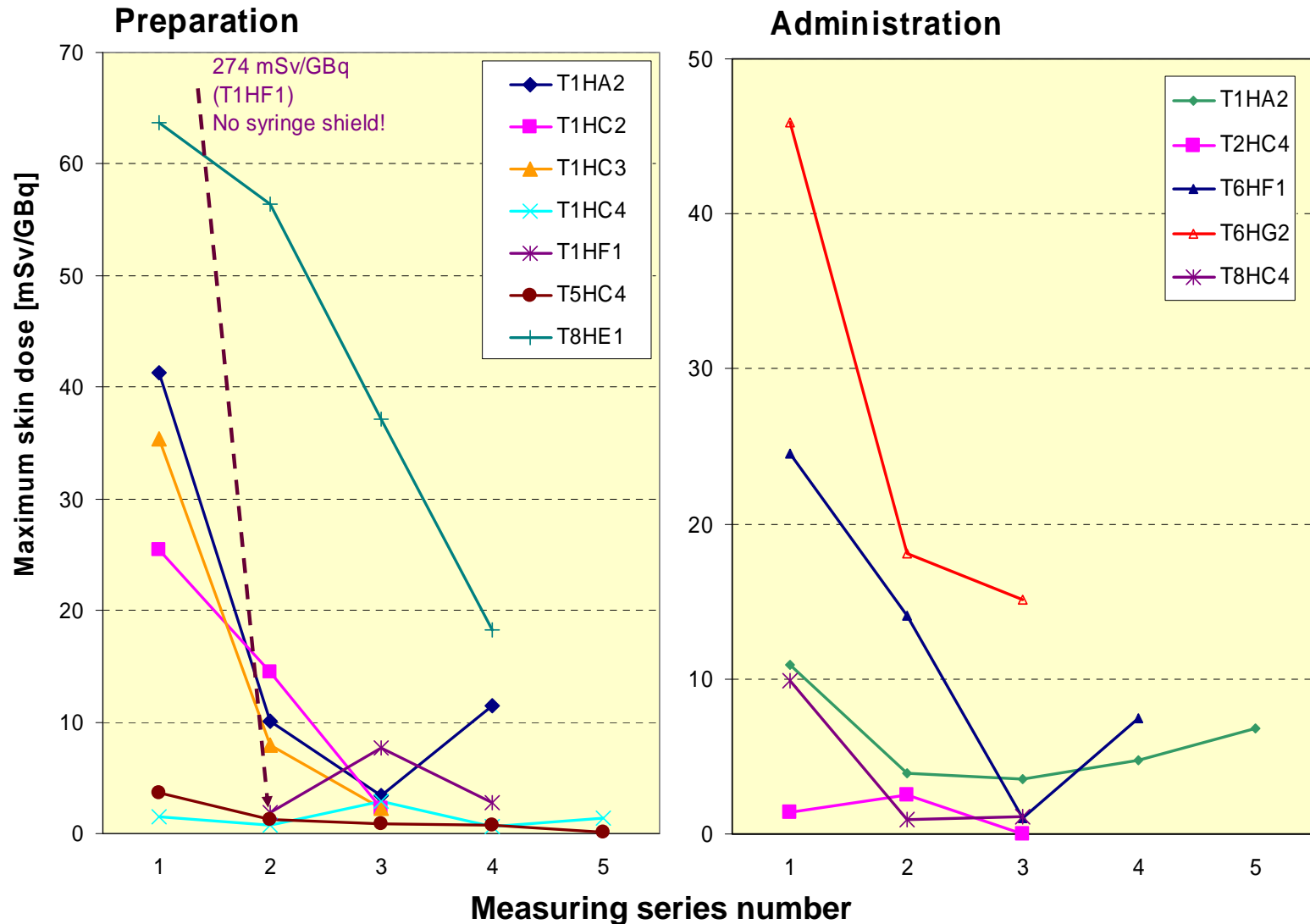
RESULTS

Maximum skin dose in Y-90/Zevalin administration

	Maximum dose in mSv/GBq							
	Non-dominant hand				Dominant hand			
	Mean	Median	Min	Max	Mean	Median	Min	Max
All workers with outliers	7.7	3.4	0.1	78.3	4.1	1.7	0.1	45.9
Without outliers	4.3	2.8	0.1	24.6	2.4	1.3	0.1	14.0

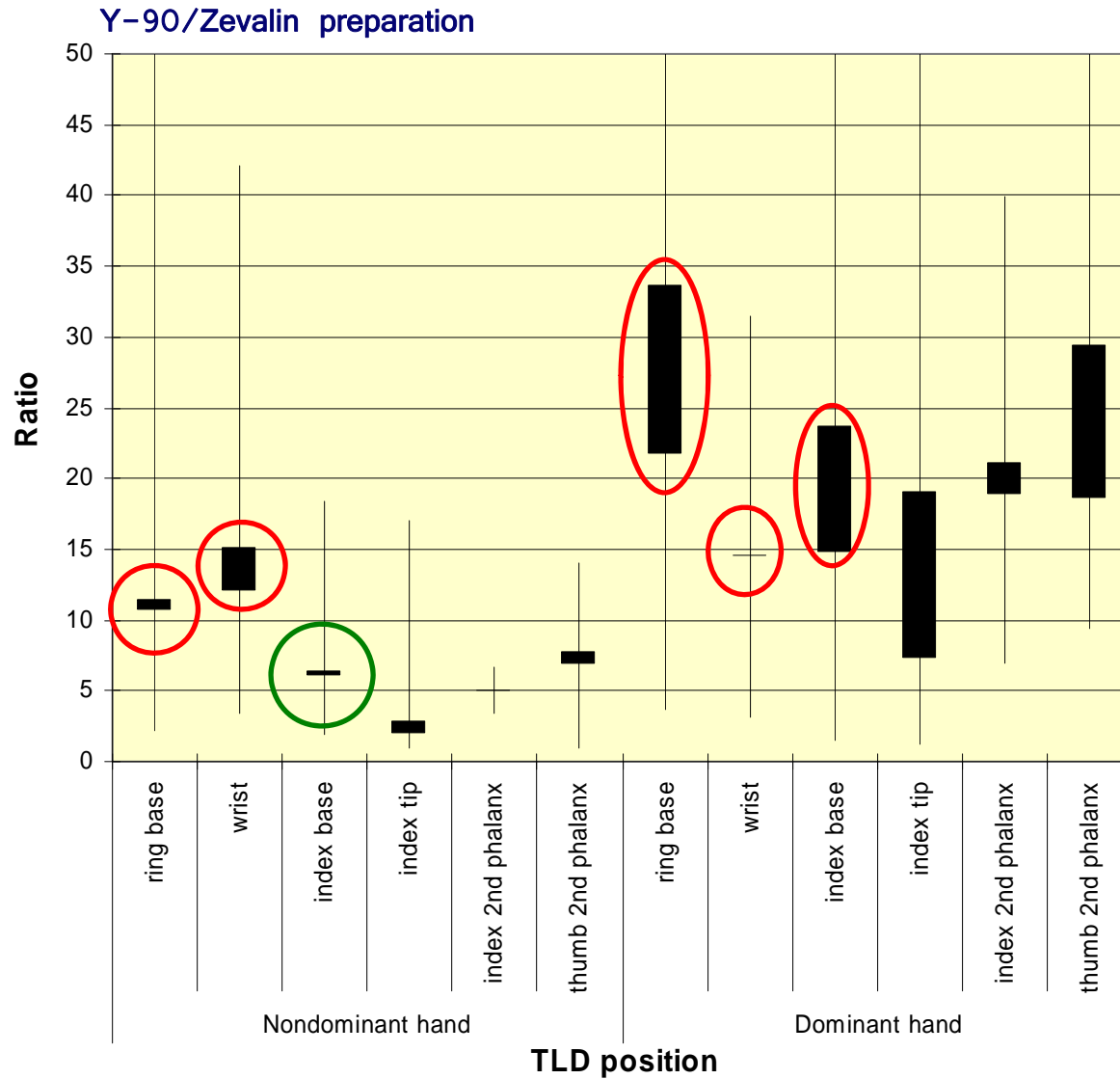
- *Non-dominant hand is higher exposed than dominant hand*
- *Highest exposed positions: tip of index finger and thumb*

Dose history of workers in RIT with Y-90/Zevalin



CONCLUSIONS - STAFF EXPOSURE

- Wide ranges of individual exposures (min/max) reflect different practices, equipment, RP means and tools used in NM therapy with Y-90
- Exposures in preparation of radiopharmaceuticals are higher than in administration (e.g. Zevalin: 17 mSv vs 5 mSv per patient on average)
- Shielding of vials and syringes is essential and a precondition but not a guarantee for low exposures
- Other RP tools and measures which were not registered in the protocol (e.g. pincers, forceps etc.) significantly affect exposures
- Use of shielding and protective tools can not be compensated by increased working speed
- Also subjective factors e.g. risk awareness and training affect exposures
- Exposure of staff members has reduced in the course of the project due to the feedback of the measurement results on the RP standard



Ratio of maximum dose on both hands to dose on dosimeter positions

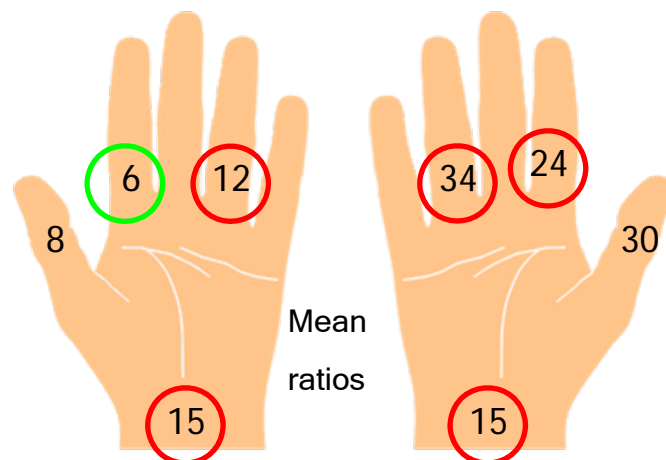


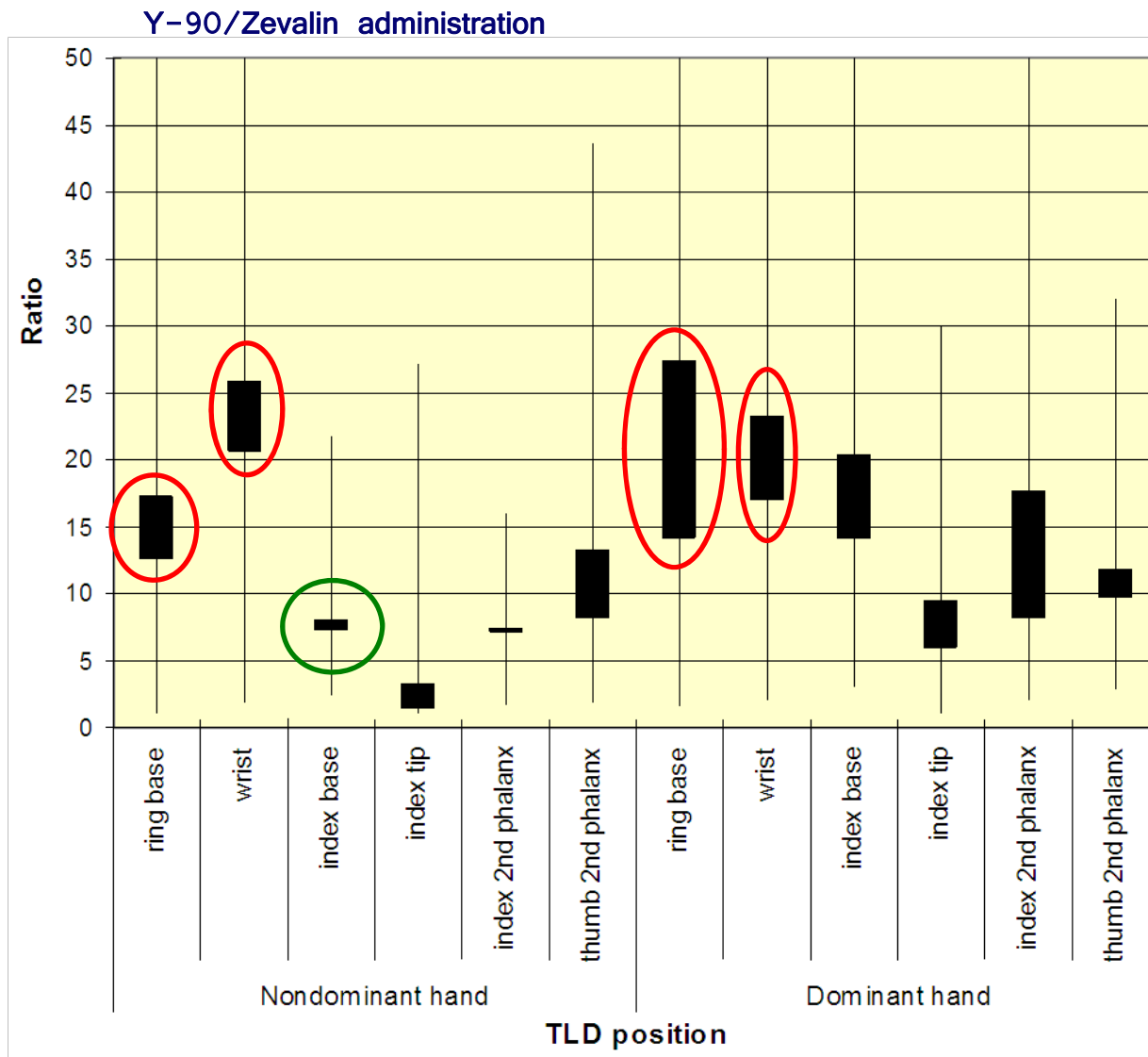
RESULTS

Y-90/Zevalin preparation

Ratio to dose maximum	Non-dominant hand				Dominant hand			
	ring base	wrist	index base	thumb 2nd phal.	ring base	wrist	index base	thumb 2nd phal.
Mean	11.5	15.1	6.4	7.8	33.7	14.5	23.7	29.5
Median	10.6	12.0	6.0	6.9	21.6	14.4	14.7	18.5
Max	50.8	42.1	18.4	14.0	85.4	31.5	78.6	95.5
Min	2.2	3.4	1.9	1.0	3.6	3.1	1.5	9.5

Ratio of maximum dose on both hands to dose on dosimeter positions





Ratio of maximum dose on both hands to dose on dosimeter position

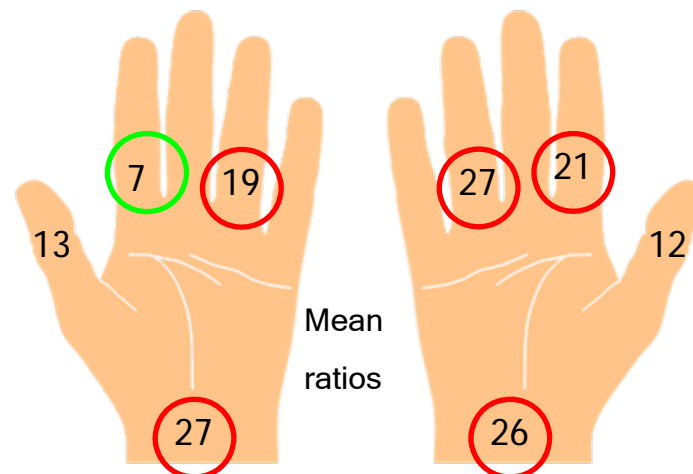


RESULTS

Y-90/Zevalin administration

Ratio to dose maximum	Non-dominant hand				Dominant hand			
	ring base	wrist	index base	thumb 2nd phal.	ring base	wrist	index base	thumb 2nd phal.
Mean	18.6	27.1	7.4	13.3	26.8	25.6	21.1	11.8
Median	12.5	21.4	7.3	8.0	14.9	16.9	12.4	9.6
Max	88.5	102.0	17.6	43.6	90.0	45.6	60.2	32.0
Min	1.0	5.2	2.6	1.9	1.6	2.1	3.0	2.9

Ratio of maximum dose on both hands to dose on dosimeter positions





CONCLUSIONS - MONITORING

- The tip of the index finger or thumb of the non-dominant hand receive most often the highest exposure
- Ring dosimeters should be worn on these fingers, preferably on the base of the index finger
- Even if the dosimeter is worn on the base of the index finger, the skin dose maximum is considerably underestimated by a factor of about 6-7
- The ringfinger base of the dominant hand, where ring dosimeters are often worn, is not a proper position in routine monitoring
- Wrist dosimeters are not appropriate for monitoring NM staff



SUMMARY

- The ORAMED project has provided the most comprehensive data on staff exposure in NM therapies so far
- Local skin dose can exceed the limit (500 mSv/a) by numerous workers in hospitals where RP standard is low
- There is adequate potential to further improve RP and decrease exposures
- Adequate skin dose monitoring is urgently needed in NM therapy

