

# Use of a Rampart Radiation Protection System to reduce staff dose in Cath Lab



Fig. 1. Rampart IC Radiation Protection Device<sup>1</sup>

## Introduction

A recent study found that up to 56% of Interventional Cardiologists suffer from back pain which could be attributed to the wearing of lead aprons.<sup>2</sup> An unwanted side-effect in the effort to reduce radiation exposure, another occupational hazard, to Operators in Cath Lab. With that in mind, the Rampart system (see Fig.1) was designed by an interventional cardiologist with the aim of removing the necessity to wear lead aprons for Cath Lab Operators. The device includes acrylic panels which provide 1mm Pb equivalent shielding and soft shielding that provides 0.5 mm Pb equivalent. The Rampart system was employed over two weeks in two of our Cath Labs and instantaneous dose rate (IDR) measurements were recorded at various staff positions around the device. For the second week an additional lead shield was attached to the support arm for further protection to the abdomen.

Subsequent measurements were made for the same staff positions without the Rampart system in place using the current radiation protection measures (ceiling shield and table lead skirt) to compare radiation protection performance.

## Methods

- IDR measurements were recorded using a Raysafe X2 Survey meter (H\*(10) rate, 0 µSv/hr – 150 mSv/h ± 10%) during interventional cardiac procedures.
- Measurements were made for the Cardiologist (Operator 1) closest to the patient head, Operator 2 assisting the Cardiologist, Radiographer, circulating nurse (positioned behind Operator 1 at a trolley), TOE operator (based at the patient head on the opposite side of the table to the cardiologist) for structural cardiac procedures and anaesthetist, see Fig. 2.
- IDRs were measured at body height at each staff position and eye and knee height for Operator 1 and the circulating nurse. These were then averaged for the different procedures and c-arm angles with and without the Rampart in place.

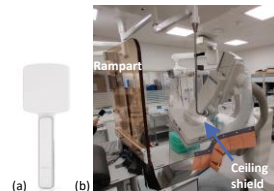


Fig. 2(a). Raysafe Survey Meter used to record IDR measurements. (b) Rampart IC Radiation Protection Device set-up & ceiling shield from TOE Operator side.

## Results

The system was installed close to Operator 1, see Figure 3. Initial set-up of the system by a trained company representative took 5 minutes including placing sterile drapes over the device, attaching an additional extended lower table shield and using small lead shields to close any gaps between the table and lower table shield. Collisions occurred frequently between the Rampart and C-arm during coronary angiograms but fewer adjustments were required for PCIs and structural cardiac procedures.

Table 1 presents dose reduction factors (DRFs) for Cath Lab staff by comparing average IDRs with and without the Rampart in place. Results showed enhanced protection for Operator 1's eyes (DRF of 18) and knees (DRF of 9). The circulating nurse's abdomen measurements also showed a DRF of 34 with the Rampart in place. The remaining staff had DRFs of 3 or less. Note that the reduction in IDR for the TOE Operator was due to the ceiling shield which could be repositioned to the other side of the patient table when the Rampart was in-situ, see Fig. 2.

Table 2 presents the hours to exceed the occupational dose limits set out in Irish legislation<sup>3</sup> using the mean IDRs recorded for the current set-up in Cath Lab, with and without PPE, and with the Rampart in place. The hours to exceed dose limits are comparable for body and extremities when comparing the Rampart to the current set-up including wearing of PPE. While the Rampart system does offer improved protection to Operator 1's eyes by a factor of ~ 4, based on estimated number of hours screening in a busy Cath Lab, this additional protection may be unnecessary.

Correct set-up of the Rampart system was paramount to ensuring optimal radiation protection. For example, an IDR of 829 µSv/hr was recorded at the cardiologist's abdomen with a gap present between the lead drapes attached to the panel situated over the patient. This reduced to 1.5 µSv/hr once the system was adjusted to form a good seal. For the second trial in week 2 an additional lead shield at abdomen height improved radiation protection to Operator 1, see Fig. 5.

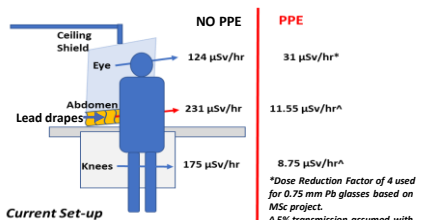


Fig. 4. Mean IDR values recorded for Operator 1 with ceiling shield and lower table shield in place. IDR values to the right take into account PPE worn and estimate actual dose to Operator 1.

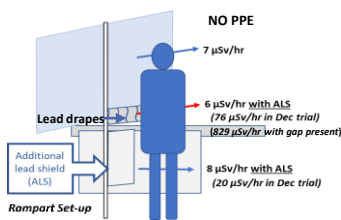


Fig. 5 Mean IDR values for Operator 1 with Rampart Device, extended lower table shield and additional lead shield.

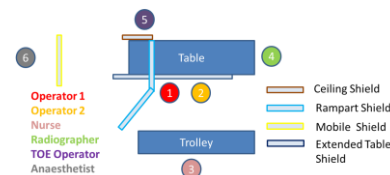


Fig. 3. Staff positions in Cath Lab and radiation shielding used during the trial

Staff Group	Measurement Position	Rampart (µSv/hr)	No Rampart (µSv/hr)	DRF
Operator 1	Eyes	7	124	18
	Abdomen	76	231	3
	Knees	20	175	9
TOE Operator	Eyes	87	91	1
	Abdomen	74	220	3
Operator 2	Knees	391	409	1
	Abdomen	1	2	2
Radiographer	Abdomen	6	7	1
Nurse	Abdomen	2	67	34
	Knees	21	46	2
Anaesthetist	Abdomen	0	33	n/a*

Table 1. Dose Reduction Factors (DRFs) for staff using the Rampart set-up as shown in Fig. 1.

	Current Set-up (no PPE)	Current Set-up (with PPE)	With Rampart (no PPE)	Estimated Annual No of Hours Screening
	Hours to exceed dose limit			
Annual Dose Limit (mSv)				
Eye (20 mSv)	161	645	2857	125*
Body (20 mSv)	86.5	1732	2857	
Knees (500 mSv)	2857	57142	62500	

\*Assuming 250 working hours per year, 10 cases per day, 3 min 39 second screening per case (based on Cath Lab audit 2021 for coronary angiograms at Mater Private Hospital)

Table 2. Comparison of hours to exceed annual dose limits<sup>3</sup> with the current shielding in Cath Lab and with the Rampart set-up. PPE includes estimated protection given by wearing lead aprons and lead glasses.

## Conclusions

The Rampart system does offer additional radiation protection to those staff closest to the device, Operator 1 and the circulating nurse, but it does not give enhanced protection to the other staff members present. The reduction in eye dose to Operator 1 is high but good fitting lead glasses will also provide adequate protection.

Incorrect positioning of the Rampart device lead to gaps which resulted in high instantaneous dose rate measurements. Dedicated trained Cath Lab staff would be required to ensure correct set-up between cases and for adjustments mid-procedure as required. For this reason, we would not advise staff to use this device without lead aprons to ensure consistency in radiation protection measures during cases.

## References

- [www.rampartic.com](http://www.rampartic.com) accessed on 5<sup>th</sup> August 2022.
- Ruhong J *et al.* Body pain – An unheeded personal health hazard in interventional cardiologists: A national online cross-sectional survey study in China. *Inter. J. of Cardiology* 2022 (350) p27-32.
- Radiological Protection Act 1991 (Ionising Radiation) Regulations 2019. S.I 30 of 2019

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