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Handling of Infusions in Nursing – a Risk for Exposure of Employees?

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Introduction

- Nursing staff in hospitals spends about 25% of the working time on application of drugs[1]
- Preparation and administration of infusions is a typical operation in hospital care
- I.v. administration used for a broad range of drugs, including well known hazardous substances (e.g. antineoplastic drugs) but also drugs often perceived as less hazardous (e.g. anti-infectives), though there is evidence for carcinogenic, mutagenic, reprotoxic or sensitising properties (CMRS) for many of these substances, too[2,3]
- Unintended leakage of infusion solution from devices such as infusion bottles, infusion sets, or cannulas may involve exposure of nursing staff to CMRS substances during operations with infusions
- **Aim: To evaluate the potential risk of exposure to infusion solution for typical nursing operations with infusions by quantifying liquid release in a simulated workflow**

Methods

- Use of 100 ml standard infusions (0.9% NaCl, polyethylene bottle) spiked with fluorescein (sodium salt, final concentration 80 µg/l) as a tracer
- Repeated simulation (3 volunteers, 15 times each) of a typical workflow comprising priming (S1) and de-capping (S2) the infusion set followed by connecting (S3) and removing (S4) the infusion to/from the i.v. cannula
- Comparison of two infusion sets: Standard set (SIS) vs. enhanced set (EIS), which can be primed without leaking of liquid due to a hydrophobic membrane in the protective cap on the Luer-Lock fitting
- Detection of liquid release after each individual work step by wipe sampling with gauze swabs (stainless steel work surface: S1, S2; glove-protected hands of the volunteers: S2) and analysis of gauze swabs placed underneath the fixed i.v. cannula (S3, S4)

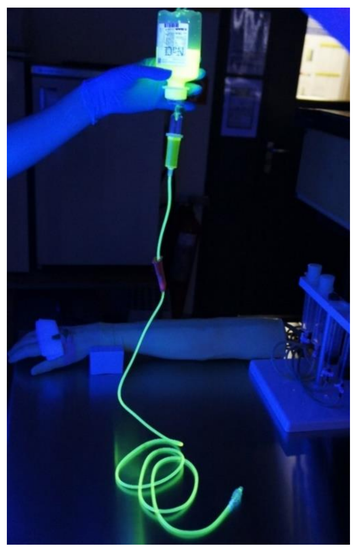

Fig. 1: Infusion spiked with fluorescein as tracer under UV light

- Extraction of gauze swabs, determination of the fluorescein concentration in extracts by HPLC/FD and calculation of the released volume

Results

- Release of up to 750 µl liquid for a one-off execution of the workflow (S1-S4)
- Contaminations found at all sampling locations including the hands of volunteers
- Substantial intra- and inter-individual variance of the measurements (Fig. 2)
- About 9-fold higher release of liquid when using the standard infusion set instead of the enhanced set (median values 226.6 vs. 26.1 µl)

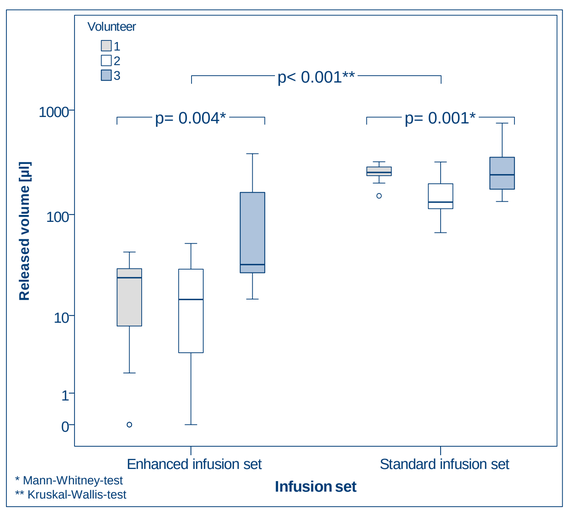

Fig. 2: Release of liquid during the simulated workflow (S1-S4, individual results for different infusion sets)

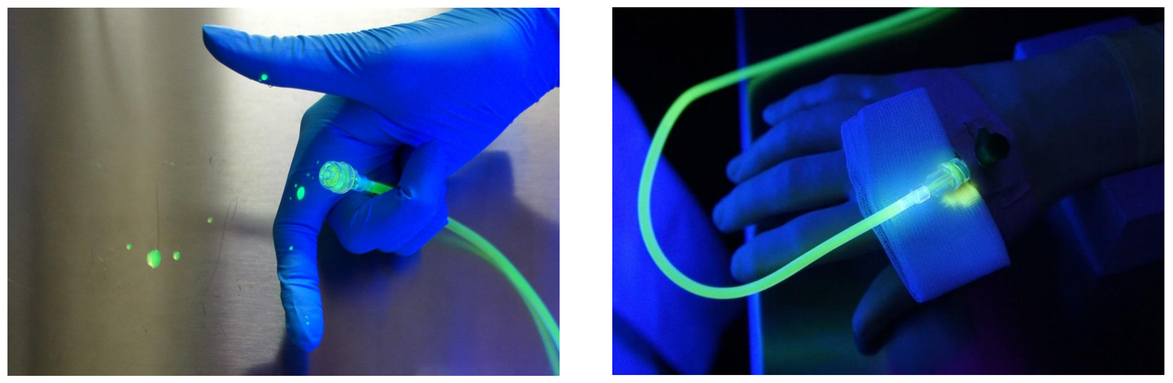

Fig. 3: Visible release of liquid after de-capping (left image) and connection to the i.v. cannula (right image)

- Lower liquid release by the EIS not only during priming (S1, as intended) but also during de-capping (S2) and connecting (S3)
- Hand contaminations during de-capping about 10-fold lower when using the EIS (median values 9.5 vs. 1.4 µl)

Tab. 1: Release of infusion solution (in µl) during individual work steps and over the total simulated work flow stratified by the used infusion set (q1-q3: interquartile range)

Work step	Sampling location	Standard infusion set (SIS)		Enhanced infusion set (EIS)	
		median	q1 - q3	**median**	q1 - q3
Priming* (S1)	work surface	**60.8**	23 - 94	**0**	0 - 0
De-capping* (S2)	hand	**9.5**	1 - 28	**1.4**	0 - 6
	work surface	**21.5**	10 - 47	**8.6**	2 - 21
Connecting to i.v. cannula* (S3)	gauze swab	**86.2**	57 - 172	**1.1**	0 - 7
Removing from i.v. cannula (S4)	gauze swab	**0**	0 - 8	**0**	0 - 10
Total workflow* (S1-S4)	all locations	**226.6**	144 - 286	**26.1**	13 - 38

* liquid release of SIS significantly different from EIS, Mann-Whitney-test p< 0.01

Discussion

- Common handling of infusions may involve a risk of exposure of nursing staff to infusion solution due to leakages
- Potential contact to CMRS substances as a result
- Neither direct exposure by contamination of hands nor indirect exposure by contaminated surfaces or gauze swabs can be excluded
- Potential exposure seems to be technically reducible by choice of appropriate infusion sets
- Contaminations found for both infusion sets may nevertheless suggest a need for additional personal protective equipment (gloves) and implementation of adequate measures of occupational hygiene

References

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