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Ethnographic study of incidence and severity of intravenous drug errors

Katja Taxis, Nick Barber

Abstract

Objectives To determine the incidence and clinical importance of errors in the preparation and administration of intravenous drugs and the stages of the process in which errors occur.

Design Prospective ethnographic study using disguised observation.

Participants Nurses who prepared and administered intravenous drugs.

Setting 10 wards in a teaching and non-teaching hospital in the United Kingdom.

Main outcome measures Number, type, and clinical importance of errors.

Results 249 errors were identified. At least one error occurred in 212 out of 430 intravenous drug doses (49%, 95% confidence interval 45% to 54%). Three doses (1%) had potentially severe errors, 126 (29%) potentially moderate errors, and 83 (19%) potentially minor errors. Most errors occurred when giving bolus doses or making up drugs that required multiple step preparation.

Conclusions The rate of intravenous drug errors was high. Although most errors would cause only short term adverse effects, a few could have been serious. A combination of reducing the amount of preparation on the ward, training, and technology to administer

slow bolus doses would probably have the greatest effect on error rates.

Introduction

In most European countries, nurses generally prepare and administer intravenous drugs prescribed by doctors. Administration of intravenous therapy is associated with considerable risk, and the UK Department of Health has targeted this to increase patient safety.¹ Similar initiatives have been proposed in the United States.²

Little prospective research has been done into the incidence, causes, and severity of intravenous drug errors. Single site studies carried out on one or two wards have reported errors in preparing and administering intravenous drugs of 13%-84%,³⁻⁶ but the studies used different definitions and did not assess the severity of errors. Epidemiological studies using retrospective record review have shown that adverse drug events are common but have not provided details of the type of errors.⁷⁻¹⁰

Participants and methods

We used a purposive sampling strategy to select study hospitals and study wards, with the aim of exploring the preparation and administration of intravenous



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Department of Practice and Policy, School of Pharmacy, University of London, London WC1 1AX

Katja Taxis assistant professor in pharmacy

Nick Barber professor of the practice of pharmacy

Correspondence to: K Taxis, Pharmazeutische Biologie, Pharmazeutisches Institut, Universität Tübingen, Auf der Morgenstelle 8, 72076 Tübingen, Germany katja.taxis@uni-tuebingen.de

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drugs in a range of settings. We selected a university teaching hospital and a non-teaching general hospital, both with about 20 wards and 400 beds. We did a pilot study to determine the frequency of use of intravenous drugs on each ward and then selected a total of 10 wards with high, medium, and low usage.

Both hospitals operated a typical British ward pharmacy service. Doctors wrote prescriptions on formatted inpatient drug charts, and nurses used the charts to determine the doses due and record the administration of drugs. Ward pharmacists ordered drugs that were not stored on the ward and reviewed the appropriateness of prescribed drugs every weekday. Nurses usually prepared and administered intravenous drugs on the wards, but cytotoxic drugs were prepared centrally by the pharmacy department. Nurses had to attend a one day training course before they were allowed to give intravenous drugs. A guide to preparation and administration of intravenous drugs was available on each ward.

Identification of errors

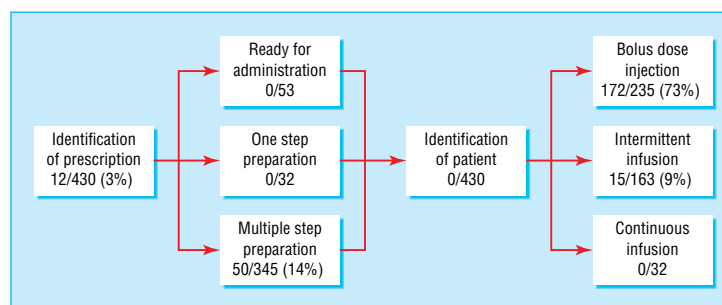
We defined an intravenous drug error as a deviation in preparation or administration of a drug from a doctor's prescription, the hospital's intravenous policy, or the manufacturer's instructions. All errors had to have the potential to adversely affect the patient, so deviations from hospital procedures, such as not checking name bands, were not considered as errors if the correct drug was given to the patient. Deviations from prescribed administration time were not considered errors. We excluded errors if they were corrected by a member of staff or the patient before administration. Errors were related to particular actions; multiple errors could occur in each case of preparation and administration.

We chose a prospective ethnographic research method to collect data. A trained and experienced observer (KT) accompanied nurses during intravenous drug rounds. She recorded the preparation and administration of each drug on a standard form. Information came from observation and talking informally to staff. The researcher intervened in a discreet and non-judgmental manner when she became aware of a potentially serious error; these incidents were still included as an error. Ward staff were told that we were investigating common problems of preparing and administering intravenous drugs; this disguised observation method has been shown to be valid.¹¹ The researcher avoided the word error to prevent the study from appearing threatening to staff.

Data were collected on 6-10 consecutive days on each ward between June 1999 and December 1999. To be representative, the study included weekends and all times of drug rounds on each ward. The researcher attended two to three drug rounds out of the four that took place each day.

Importance of errors

We used a validated scale to assess the clinical importance of intravenous drug errors.¹² Briefly, four experienced healthcare professionals (one doctor, one nurse, and two pharmacists) scored the potential clinical importance of each drug error from zero (labelled as no harm) to 10 (death). The mean score was calculated for each drug error. Mean scores below 3 suggested a minor outcome, scores of 3-7 a moderate outcome, and scores above 7 a severe outcome.



Stages and errors in preparation and administration of intravenous drugs (numbers of errors/number of observations of each stage)

Analysis of data

The data on the incidence of intravenous drug errors is expressed in two ways: errors per dose and errors per process stage (see bmj.com), and we calculated proportions and 95% confidence intervals.

Results

A total of 113 nurses and one doctor were observed over 76 days. Altogether 1042 doses of intravenous drugs, representing 35 different drugs, were prescribed for 106 patients during the study. Our observations were representative for the study period: 41% (430) of all intravenous drug doses prescribed were observed; administrations of 91% (32) of the prescribed drugs was observed at least once; and 92% (98) of patients who were prescribed regular intravenous drugs were observed at least once. The researcher intervened in 12 cases to prevent an error reaching the patient.

One or more errors occurred in the preparation and administration of 212 out of 430 intravenous drug doses (error rate 49%, 95% confidence interval 45% to 54%). A total of 249 errors were identified. Preparation errors occurred in 32 intravenous doses (7%), administration errors in 155 doses (36%), and both types of error in 25 doses (6%). Errors were potentially severe in three doses (1%), potentially moderate in 126 (29%), and potentially minor in 83 (19%). See bmj.com for examples.

The figure shows the incidence of errors at each stage of drug preparation and administration. Most preparation errors were associated with multiple step preparations—for example, drugs that required reconstitution with a solvent and addition of a diluent. Typical errors were preparing the wrong dose or selecting the wrong solvent. All three severe errors occurred at

Type and clinical importance of errors in preparation and administration of intravenous drugs. Values are numbers (percentages) of errors in 430 observations

Type of error*	Importance of error			Total
	Minor	Moderate	Severe	
Preparation errors:				
Errors in solvent/diluent	20 (5)	16 (4)	0	36 (8)
Wrong dose	0	11 (3)	1 (0.2)	12 (3)
Omission	0	12 (3)	0	12 (3)
Other	0	0	2 (0.5)	2 (0.5)
Administration errors:				
Fast bolus dose (peripheral line)	64 (15)	63 (15)	0	127 (30)
Fast bolus dose (central line)	14 (3)	22 (5)	0	36 (8)
Incompatibilities	1 (0.2)	11 (3)	0	12 (3)
Other	3 (7)	9 (2)	0	12 (3)

*No errors were observed in the categories of preparing the wrong drug, using an unauthorised drug, or administration to the wrong patient.

this stage. A few errors occurred in identifying prescriptions—for example, not seeing a drug order. Most errors occurred when giving bolus doses, with errors in 172/235 (73%) doses. In most of these cases (163, 95%) the dose was given faster than recommended, which is usually three to five minutes; more than half of these errors (85, 52%) were considered to be of potential moderate severity. The table gives a more detailed analysis of the type and severity of the errors.

Discussion

Although the proportion of serious errors is small, the number of patients and intravenous doses in a hospital means that errors may be more common than expected. A point prevalence study we carried out in the university teaching hospital (400 beds) showed that about 112 (28%) of inpatients received intravenous drugs, resulting in more than 300 doses a day. Although we cannot extrapolate with any precision, our data suggest that at least one patient will experience a potentially serious intravenous drug error every day in a hospital of that size. Hence, intravenous drug errors are a potential source of serious harm for patients and risk reduction strategies should be developed accordingly.

Reducing the risks

Our analysis shows that the two weak stages in the system are drugs that require multiple step preparation and administration of doses as a bolus. Several strategies could be used to reduce multiple step preparation errors. Centralised preparation of intravenous drugs by the pharmacy department was suggested in the 1970s in the United Kingdom but was rarely adopted.¹³ Centralised preparation of intravenous drugs is common in the United States¹⁴ but not in Europe, apart from in specialised areas such as oncology.¹⁵ The evidence for centralised services is currently weak, and it is unclear whether they are cost effective or improve the quality of the service.¹⁶⁻¹⁹ An alternative strategy would be to purchase ready prepared intravenous drugs from pharmaceutical companies.

The effect of the above changes would have to be assessed carefully. New types of errors could be introduced, such as transmission errors from the ward to the preparation department.²⁰ Furthermore, nurses who are no longer used to preparing intravenous drugs may make serious errors if they have to prepare drugs in an emergency.

Technical solutions could reduce the frequent errors from rapid bolus injections—for example, a pump that prevents fast administration of bolus doses. Staff training could improve awareness of drugs that have a high risk of adverse effects when given too fast. A warning could also be put on the drugs by the pharmacy.

Validity of study

The effect of the observer on the observed is often discussed as a possible limitation of ethnographic observation methods.²¹ The error rate may be even higher in the absence of the researcher. However, a previous observation based study using a similar method showed that the drug error rate is unlikely to be affected by the observer, even if the observer

What is already known on this topic

Errors in preparing and administering intravenous drugs can cause considerable harm to patients

Reduction of drug errors is a government health target in the United Kingdom and the United States

What this study adds

Errors occurred in about half of the intravenous drug doses observed

Errors were potentially harmful in about a third of cases

The most common errors were giving bolus doses too quickly and mistakes in preparing drugs that required multiple steps

occasionally intervenes.¹¹ The researcher seemed to have been accepted in our study, and some initial activities by nurses, such as wearing gloves to make up the doses, were soon abandoned. Using an observation based approach allowed us to explore drugs errors that would not have been documented and therefore missed by studies relying on review of hospital records.^{7 8 10}

Conclusions

Our study shows that errors in the preparation and administration of intravenous drugs remain a concern in the United Kingdom, 25 years after the problem was first highlighted. Steps to ensure the correct administration of bolus doses and to reduce mistakes in making up drugs that require multiple step preparation will have the greatest effect on error rates.

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Contributors: See bmj.com

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Discrimination in the discretionary points award scheme: comparison of white with non-white consultants and men with women

Aneez Esmail, Peter Abel, Sam Everington

The discretionary points award scheme is one of the main mechanisms for rewarding consultants beyond their basic salaries in England, Wales, and Scotland. Half of all consultants have received awards. Together, the discretionary points and distinction awards cost the NHS about £251m (\$410m; €380m) each year. Each discretionary point is worth £2645, so a consultant with the maximum of eight discretionary points earns £87 280.

Department of Health guidance for awarding points instructs employers to ensure that consultants are treated equally regardless of colour, race, sex,

religion, politics, marital status, sexual orientation, membership or non-membership of trade unions or associations, ethnic origin, age, or disability.¹ We assessed whether any disparity between the discretionary points awarded to consultants in England and Wales and in Scotland is associated with ethnic origin and sex.

Methods and results

We used data for 2000-1 from the Advisory Committee on Distinction Awards for England and Wales and the

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Medical Practitioners Union, MSF Centre, London EC1V 8HA

Aneez Esmail
president
Sam Everington
vice president

Rusholme Health Centre, School of Primary Care, University of Manchester, Manchester M14 5NP

Peter Abel
research assistant

Correspondence to:
A Esmail
aneez.esmail@man.ac.uk

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Distribution of discretionary point awards by ethnic group and sex for consultants in England and Wales and Scotland

	Race*				Sex†			
	White	Non-white	Total	Ratio‡ (95% CI)	Male	Female	Total	Ratio§ (95% CI)
England and Wales								
No eligible for award	16 411	2395	18 806	—	17 105	5284	22 389	—
No with award	9 261	983	10 244	—	9 540	2351	11 891	—
% with award	56.43	41.04	—	1.37 (1.31 to 1.44)	55.77	44.49	—	1.25 (1.21 to 1.30)
No with award beyond								
D1	7 414	706	8 120	1.53 (1.44 to 1.63)	7 622	1732	9 354	1.36 (1.30 to 1.42)
D2	5 361	459	5 820	1.70 (1.57 to 1.86)	5 540	1124	6 664	1.52 (1.44 to 1.61)
D3	4 222	326	4 548	1.89 (1.70 to 2.10)	4 408	805	5 213	1.69 (1.58 to 1.81)
D4	3 488	245	3 733	2.08 (1.84 to 2.35)	3 643	627	4 270	1.79 (1.66 to 1.94)
D5	1 319	70	1 389	2.75 (2.17 to 3.48)	1 304	223	1 527	1.81 (1.57 to 2.08)
D6	594	23	617	3.77 (2.49 to 5.70)	577	96	673	1.86 (1.50 to 2.03)
D7	235	10	245	3.43 (1.82 to 6.45)	229	45	274	1.57 (1.14 to 2.16)
Mean age (years)	36.3	39.0	—	—	36.7	37.1	—	—
Scotland								
No eligible for award	2 533	140	2 673	—	2 087	677	2 764	—
No with award	1 310	54	1 364	—	1 136	270	1 406	—
% with award	51.7	38.5	—	1.34 (1.08 to 1.66)	54.4	39.9	—	1.36 (1.23 to 1.51)
No with award beyond								
D1	984	29	1 013	1.88 (1.35 to 2.60)	869	174	1 043	1.62 (1.41 to 1.86)
D2	707	19	726	2.06 (1.35 to 3.14)	635	103	738	2 (1.65 to 2.42)
D3	503	6	509	4.63 (2.11 to 10.18)	457	66	523	2.25 (1.76 to 2.86)
D4	394	4	398	5.44 (2.06 to 14.36)	359	50	409	2.33 (1.76 to 3.09)
Mean age (years)	35.4	40.4	—	—	35.7	35.5	—	—

*In England and Wales, 2425 consultants, and in Scotland, 91 consultants did not give their ethnic group and we classified 1172 as "other ethnic group."

†In England and Wales, 14 consultants did not provide information.

‡In England and Wales, χ^2 for the linear trend was 316 ($P<0.0001$); in Scotland χ^2 was 35 ($P<0.0001$).

§ In England and Wales, χ^2 for the linear trend was 347 ($P<0.0001$); in Scotland χ^2 was 79 ($P<0.0001$).