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Patient records analysis for potentially preventable adverse drug events leading to acute kidney injury following a propensity matched cohort study

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Background and Purpose

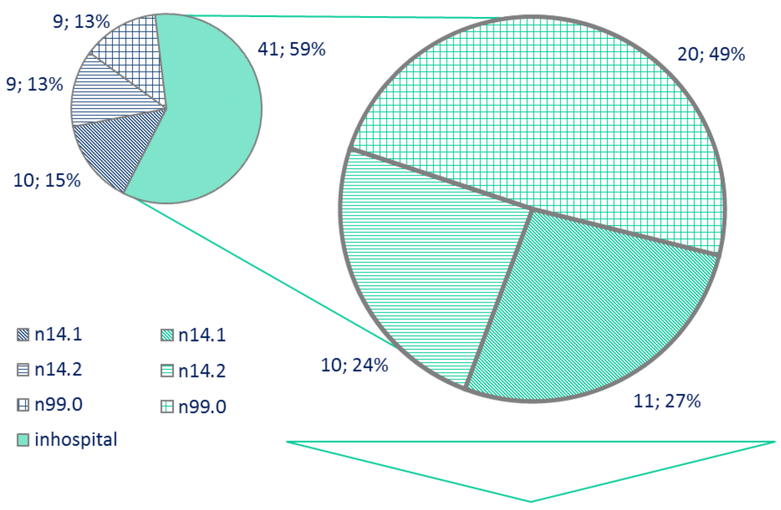
Relevant adverse drug events (ADE) are often documented in clinical administrative data (CAD) using ICD-10 codes (International Classification of Diseases, 10th revision). In a previous propensity-matched cohort study we analysed the CAD of 48,072 inpatients of a university hospital in 2012 for potentially preventable inpatient ADE affecting the length of stay. From a hospital's perspective, particularly ICD-10 codes coding for drug-induced renal failure appeared potentially preventable.

We now aimed to evaluate the usability of these particular ICD-10 codes as inhospital ADE markers and analysed causes and conditions leading to acute kidney injury (AKI) in the hospital to develop prevention strategies.

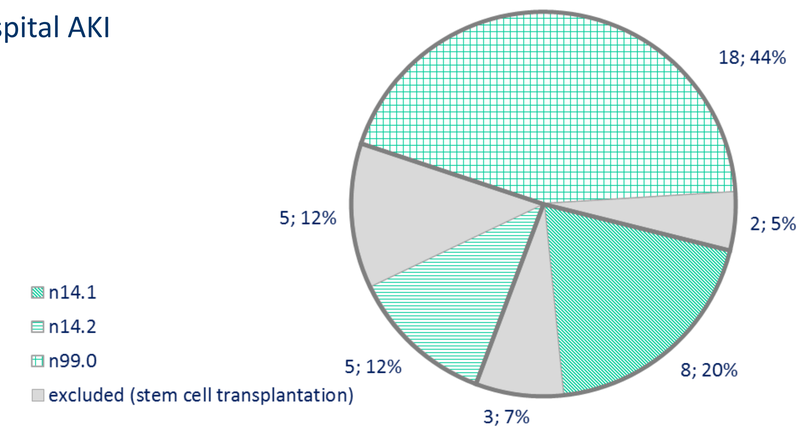
Results: Validity of Codes

The records of all 69 patients with ICD-10 codes coding for drug-induced renal failure were analysed (mean age 62 (range 23-94), 33 % female). Fourty-one patients had an inhospital AKI. Ten patients admitted for stem cell transplantation were excluded because in these patients kidney injury occurs very often and is usually multi-causal. In nine patients no causative drug could be defined for causality assessment (peri-operative AKI, n = 6; multiorgan dysfunction, n = 2; bilateral nephrectomy, n = 1). This leads to 22 patient cases where causality assessment was done by both reviewers (Figure 1).

All 69 patient cases
- 28 (41 %) with renal failure known at admission (blue)
- 41 (59 %) with inhospital AKI (green)



41 patient cases with inhospital AKI
- 10 were admitted for stem cell transplantation and therefore excluded



31 patient cases eligible for causality assessment
- 20 patient cases with an AE that was rather unlikely drug-induced, thereof 9 patient cases without causative drug identifiable
- 11 patient cases with a rather likely drug-induced AE

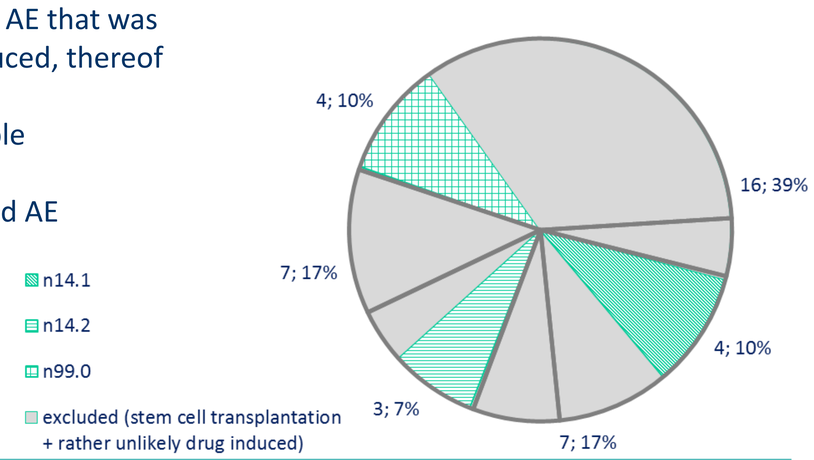


Fig. 1 Proportion of cases with ICD-codes for drug-induced kidney injury present at admission (blue) and developed inhospital (green).

Materials and Methods

Validity of previously identified ICD-10 codes that are used for coding of drug-induced renal failure (Table 1) was verified by patient record analysis.

Tab. 1 ICD-10 codes coding for drug-induced renal failure, code description

N14.1	Nephropathy induced by other drugs, medicaments and biological substances
N14.2	Nephropathy induced by unspecified drug, medicament or biological substance
N99.0	Postprocedural renal failure

Relevant information was extracted from the patient record and summarized in a standardized form for each patient case . The form displays:
- Patient age and gender, as well as information on hospital stay
- Known and new diagnoses
- Drugs taken before and during inhospital stay and at discharge
  - dosage, route of administration, start and end date
- Documentation of the adverse event (AE) according to the coded ICD-10 code
- AE-related history, explicitly checking for
  - NSAIDs and iodinated contrast agents
  - Renal replacement procedures and
  - Low blood pressure and/or severe infections
- Further clinical course and complications and
- Conceivable prevention strategies.

Acute kidney injury was defined according to the KDIGO guidelines (1) and verified by laboratory values of creatinine throughout the inhospital stay. All cases with identified inhospital AKI were assessed for their likelihood of being drug-related. Two reviewers (DC, SA) independently applied the causality score according to the updated French method for causality assessment. (2, Table 2). In case of diverging results, ratings were discussed to reach consensus. Using techniques of root cause analysis we looked for preventive strategies.

Tab. 2 Causality assessment (2): The result is a numerical score, ranging from 0 (lowest possible score) to 6 (highest possible causality score). We defined drugs with a score of 0-3 as rather unlikely causative and drugs with a score of 4 to 6 as rather likely being causative of the AE.

0	1	2	3	4	5	6
Rather unlikely causative				Rather likely causative		

Results: Causality Assessment and Preventive Strategies

Both reviewers conducted 25 causality assessments in 22 cases for 16 different drugs. From these drugs, seven were rather likely causative of the adverse event (Figure 2).

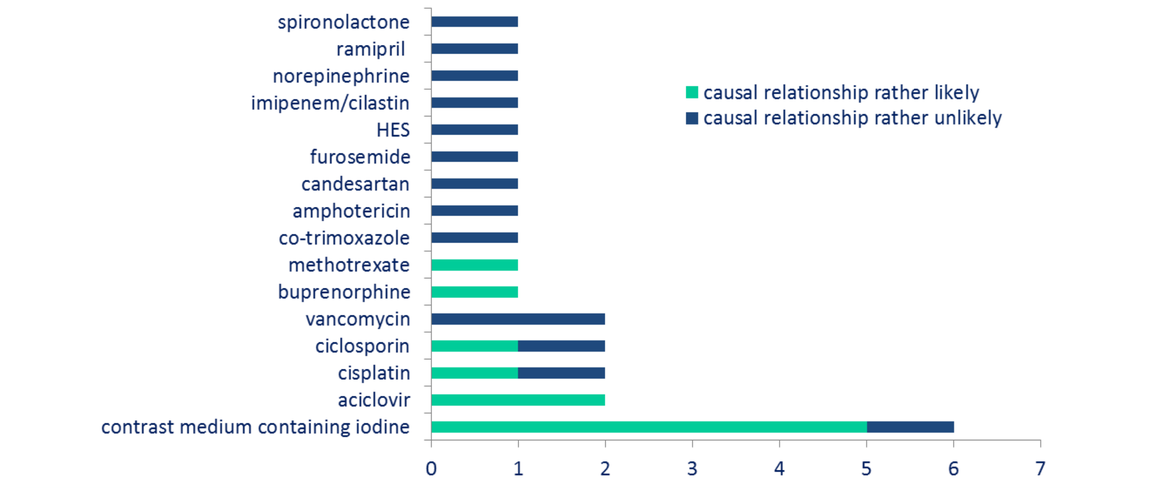


Fig. 2 Drugs and number of patient cases, where causality assessment was done by both reviewers. Blue bars indicate a rather unlikely causal relationship to the adverse event, green bars indicate a rather likely causal relationship to the adverse event.

Out of the 11 cases with rather likely causal relationship, we exemplarily derived potential prevention strategies for three different drugs:
- Aciclovir: careful dose adjustment and/or more vigorous hydration protocols in patients with known chronic kidney disease
- Methotrexate: closer monitoring and documentation of hydration and urine alkalization protocols
- Contrast media containing iodine: adequate fluid intake and/or monitoring of renal excretion and/or administration of minimum possible doses.

Conclusions

Our findings do not support the usability of ICD-10 coding for drug-induced renal failure as a trigger for risk management in order to prevent inhospital AKI: The number of previously identified inhospital AKI via ICD-10 codes is low and the number of patient cases where a drug seems causative of the AKI is even lower.

Based on the partly incomplete data available on the patient records, postulated prevention strategies can only be seen as first suggestions. The actual need for the mentioned suggestions on prevention would need prospective verification in routine care. Unless CAD do not explicitly flag inpatient ICD-10 codes, and underreporting cannot be overcome, CAD-based ADE identification is laborious and adequate risk management by the hospital challenging.

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References:
(1) Section 2: AKI Definition. Kidney Int Suppl (2011) 2012;2:19-36
(2) Arimone Y, et al. Therapie 2013;68:69-76.