Summary of studies on the rates of medication errors across the medicines management system in primary care

<table>
<thead>
<tr>
<th>Reference</th>
<th>Year of study</th>
<th>Country</th>
<th>Study setting</th>
<th>Method of identification</th>
<th>Study Design</th>
<th>Type of error</th>
<th>Incidence/rate reported</th>
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</thead>
<tbody>
<tr>
<td>Abramson et al. (2011)</td>
<td>2005/2006</td>
<td>USA</td>
<td>78 Community-based primary care providers across two states</td>
<td>Prescription and medical record review</td>
<td>Non-randomized retrospective study</td>
<td>Prescribing</td>
<td>Errors in prescriptions and prescribing; 36.7/100 prescriptions (95% CI 30.7-44.6), excluding illegible errors</td>
</tr>
<tr>
<td>Al-Khaja et al. (2007)</td>
<td>2004</td>
<td>Bahrain</td>
<td>20 primary health care centres</td>
<td>Audit of paediatric prescriptions</td>
<td>Retrospective clinical prescription review</td>
<td>Prescribing</td>
<td>Omission (minor and major), commission (incorrect information) and integration errors (e.g. Drug interaction)</td>
</tr>
<tr>
<td>Al-Khaja et al. (2005)</td>
<td>2003</td>
<td>Bahrain</td>
<td>18 primary health care centres</td>
<td>Pharmacy staff screened prescriptions for errors; audit of prescriptions</td>
<td>Prospective clinical prescription review</td>
<td>Prescribing</td>
<td>Near miss: incident that was detected up to, including the point at which medication was handed over to patient or their representative</td>
</tr>
<tr>
<td>Ashcroft et al. (2005)</td>
<td>2004</td>
<td>UK</td>
<td>35 community pharmacies</td>
<td>Pharmacist-led identification</td>
<td>Prospective study</td>
<td>Dispensing</td>
<td>Near miss: incident that was detected up to, including the point at which medication was handed over to patient or their representative</td>
</tr>
<tr>
<td>Avery et al. (2012)</td>
<td>2010</td>
<td>UK</td>
<td>15 general practitioners from four Primary Care Trusts</td>
<td>Review of patient clinical or medical records, healthcare professional interviews</td>
<td>Randomised retrospective study</td>
<td>Prescribing, monitoring</td>
<td>Prescribing error occurs when, as a result of a prescribing decision or prescription-writing process, there is an unintentional, significant reduction in the probability of treatment being timely and effective, or increase in the risk of harm when compared to a generally accepted practice; Monitoring error occurs when a prescribed medicine is not monitored in the way which would be considered acceptable within routine general practice</td>
</tr>
<tr>
<td>Barber et al. (2004)</td>
<td>2003</td>
<td>UK</td>
<td>256 residents from 15 nursing/residential homes</td>
<td>Patient interview, case review, practice observation, dispensed items examination</td>
<td>Prospective study of random sample of residents within a purposive sample of homes</td>
<td>Prescribing, Dispensing, Administration, Monitoring</td>
<td>Prescribing error - deviations from prescribing standards in decision and writing (Dean et al., 2000); Monitoring - deviations from monitoring standards (Murphet et al., 2008); Dispensing - deviations from prescriptions and orders (Dean et al., 2005); Administration - variations between prescriptions and administrations (Dean and Barber, 2001)</td>
</tr>
<tr>
<td>Cameron et al. (2008)</td>
<td>2006</td>
<td>UK</td>
<td>2, 480 residents from 42 primary care based regional aged care facilities (RACF)</td>
<td>Audit of the accuracy of dose administration aids (DAH)</td>
<td>Prospective observation (prior to patient administration)</td>
<td>Prescribing, Dispensing, Administration, Monitoring</td>
<td>Comparison of drug charts prepared by patients’ GPs with contents of DAH by registered nurses. Discrepancies were recorded as incidents</td>
</tr>
<tr>
<td>Chen et al. (2006)</td>
<td>1999/2000</td>
<td>UK</td>
<td>4 General practices with an estimate of 37, 940 patients</td>
<td>Review of computerised patient medical record</td>
<td>Retrospective review of identified potential drug-drug or drug-disease interactions</td>
<td>Dispensing</td>
<td>Potential for serious drug drug interactions or drug-disease interactions (contraindications)</td>
</tr>
<tr>
<td>Chua et al. (2001)</td>
<td>2002</td>
<td>UK</td>
<td>4 conveniently-sampled community pharmacies within the Hull and East Riding Pharmacy Research Network, North of England</td>
<td>Review and analysis of self-recorded dispensing errors and ‘near misses’</td>
<td>Prospective audit</td>
<td>Dispensing</td>
<td>Near miss: dispensing error identified by pharmacy prior to patient receipt of medication; Dispensing error - recorded if error discovered following patient receipt</td>
</tr>
<tr>
<td>Shafie et al. (2011)</td>
<td>2010</td>
<td>Malaysia</td>
<td>Primary care setting of a University, Universiti Sains Malaysia (USM)</td>
<td>Review of data from 1 academic year using computerised databases</td>
<td>Retrospective study</td>
<td>Prescribing, Dispersing</td>
<td>Drug contra-indications</td>
</tr>
<tr>
<td>Issell et al. (2007)</td>
<td>2007</td>
<td>USA</td>
<td>Large multi-speciality group practice with 30,000 enrollees</td>
<td>Electronic tracking of administrative data, prescription reports, hospital discharge summary, emergency visits</td>
<td>Retrospective review of identified potential drug-drug or drug-disease interactions</td>
<td>Dispensing, Administration</td>
<td>Potential adverse drug events due to patient errors during medication use</td>
</tr>
<tr>
<td>Byrne et al. (2000)</td>
<td>2008</td>
<td>UK</td>
<td>100 Community pharmacy chains pharmacies in large metropolitan areas of four states</td>
<td>Underfilled ‘shoppers presented non-real life prescriptions</td>
<td>Retrospective observation of dispensed items</td>
<td>Dispensing</td>
<td>Variation between prescription and dispensed item (accuracy of dispensing)</td>
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</table>
### Reference Table for Medication Errors in Primary Care

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<th>A</th>
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<tr>
<td>Gandhi et al (2003)</td>
<td>2002</td>
<td>USA</td>
<td>Outpatient prescriptions of residents in Northeastern USA</td>
<td>Retrospective review of claims data</td>
<td>Prescribing</td>
<td>Drug interactions - presence of minimum of 5-day overlap in days supply for drugs in an interesting pair</td>
<td>21(1/10,000) items prescribed (0.1%); 89(4 potential drug interactions detected)</td>
<td></td>
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<tr>
<td>Lasser et al (2000)</td>
<td>2002</td>
<td>USA</td>
<td>51 ambulatory practices in greater Boston area</td>
<td>Retrospective study</td>
<td>Prescribing</td>
<td>Prescribing - drug-drug interactions and drug-disease interactions with little to no potential for harm; Monitoring error - drug-laboratory monitoring interactions with little or no potential for harm (violations of the ‘black box’ or labeling warnings in Physicians’ Desk Reference (PDR))</td>
<td>2,254 patients of 37,779 examined prescription in situation of warning (ca. 70% of patients prescribed at least one medication containing warfarin CR 1.7% of all patients prescribed warfarin)</td>
<td></td>
</tr>
<tr>
<td>Gandhi et al (2003)</td>
<td>2003</td>
<td>USA</td>
<td>1,827 prescriptions of 1,202 patients at four adult primary care practices in Boston, USA</td>
<td>Prescription review, chart review</td>
<td>Prospective cohort study</td>
<td>Administration, Monitoring (laberror reactions from errors)</td>
<td>Preventable adverse drug events - due to error which could have been avoided, ameliorable - those whose severity or duration could have been reduced</td>
<td></td>
</tr>
<tr>
<td>Knudsen et al (2007)</td>
<td>1999/2000</td>
<td>USA</td>
<td>Medicare enrollees (50-107 years of persons alive at baseline) in a multiplicity group practice &gt;65 years</td>
<td>Review of provider reports, discharge summaries, emergency department notes, computer-generated signals, electronic clinic notes, incident reports</td>
<td>Retrospective cohort study</td>
<td>Prescribing, Monitoring, Administration</td>
<td>A medication error - any error that occurred in the medication use process. The subset of these errors related to prescribing errors. Errors causing injury were preventable; those with potential to cause injury were potential ADEs.</td>
<td></td>
</tr>
<tr>
<td>Kaushal et al (2005)</td>
<td>2005</td>
<td>Germany</td>
<td>Nation-wide study in 1,146 community pharmacies in Germany</td>
<td>Prospective study</td>
<td>Prescribing, Administration (‘patient level’); Dispensing (delivery levels)</td>
<td>A drug-related problem (DRP) - an event or circumstance that actually or potentially interferes with desired health outcomes with potential for ineffective pharmacotherapy and/or drug-related mortality and morbidity.</td>
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<tr>
<td>Gandhi et al (2003)</td>
<td>2004</td>
<td>USA</td>
<td>Retrospective study of 1,063 patients from 26 primary care practices in New York City</td>
<td>Chart review</td>
<td>Prospective cohort study</td>
<td>Medication errors - errors in medication ordering, transcribing, dispensing, administration, and monitoring, with minimal potential for harm and near misses; Preventable ADEs were medication errors that caused harm</td>
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<td>Kaushal et al (2007)</td>
<td>2002</td>
<td>Saudi Arabia</td>
<td>Retrospective study of 10 general practitioners in Riyadh City</td>
<td>Chart review</td>
<td>Prospective cohort study</td>
<td>Medication errors - errors in medication ordering, transcribing, dispensing, administration and monitoring, with potential for harm and near misses; Preventable ADEs were medication errors that caused harm</td>
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<tr>
<td>Kaushal et al (2007)</td>
<td>2002</td>
<td>Denmark</td>
<td>60 randomly-selected Danish community pharmacies</td>
<td>Chart review</td>
<td>Prospective cohort study</td>
<td>Monitoring error - events that happened in the practice that should not have happened, which staff were willing to prevent and those that did not happen but should have (so they related to medication)</td>
<td>Medication error rate (0.13%); Total errors (of 1,523 total adverse drug events; of these, Preventing errors = 16.2%, Monitoring = 16.2%, Administration = 5.8% (all of total events))</td>
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<td>Kaushal et al (2007)</td>
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<td>Gandhi et al (2003)</td>
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<td>Nationwide study in 1,146 community pharmacies in Germany</td>
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<td>Prescribing, Administration (‘patient level’); Dispensing (delivery levels)</td>
<td>A drug-related problem (DRP) - an event or circumstance that actually or potentially interferes with desired health outcomes with potential for ineffective pharmacotherapy and/or drug-related mortality and morbidity.</td>
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**Definitions used for data collection:***
- **Prescribing**
  - Drug interactions: presence of minimum of 5-day overlap in days supply for drugs in an interesting pair
  - Medication errors: errors in medication ordering, transcribing, dispensing, administration, and monitoring, with minimal potential for harm and near misses; Preventable ADEs were medication errors that caused harm
- **Dispensing**
  - Medication errors: errors in medication ordering, transcribing, dispensing, administration, and monitoring, with potential for harm and near misses; Preventable ADEs were medication errors that caused harm
- **Administration**
  - Monitoring error: events that happened in the practice that should not have happened, which staff were willing to prevent and those that did not happen but should have (so they related to medication)
## Summary of studies on the rates of medication errors across the medicines management system in primary care

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<tr>
<td>Johney et al (2007)</td>
<td>2004</td>
<td>UK</td>
<td>15 community pharmacies within Brighten and Hove Primary Care Trust (PCT), East Sussex</td>
<td>Pharmacist-detected problems (errors) as reported during a 10-week data collection period</td>
<td>Prospective study</td>
<td>Prescribing, dispensing, administration</td>
<td>An ‘incident’ was any preventable event that may have led to or caused inappropriate use or patient harm. ‘Near miss’ was any incident up to and including the point at which the medication left the pharmacy.</td>
<td>Near miss prescriber dispensing error rate of 3.8% (95% CI 3.3 - 4.4) and 62.3% of total errors of 155 errors reported respectively; Actual prescriber dispensing, and administration error rate of 2.3, 19.3% and 7.1% of total errors (n=3, 28 and 1 of 145 errors reported) respectively</td>
</tr>
<tr>
<td>Martinez Sánchez and Campos (2011)</td>
<td>2011</td>
<td>Spain</td>
<td>1 community pharmacy</td>
<td>Pharmacist-detected problems (errors) reported during a 15-month data collection period</td>
<td>Prospective study</td>
<td>Prescribing, Transcribing</td>
<td>An error was defined as ‘any identified in the process of dispensing to interfere with initial dispensing, e.g. inadequate prescriptions/incorrect information, or potentially harmful to patients, e.g. potentially hazardous drug interactions, inappropriate doses or directions, concomitant medications, ADRs, allergies, and duplications</td>
<td>Prescribing error rate = 5.1% of total prescriptions (305 errors detected of 5937 total prescriptions); transcription error rate = 0.46% of total prescriptions</td>
</tr>
<tr>
<td>Marwaha et al (2010)</td>
<td>2010</td>
<td>India</td>
<td>Handwritten prescriptions from seven general practice physicians presented to community pharmacies</td>
<td>Retrospective review of hand-written prescriptions presented to community pharmacies during a 2-month period</td>
<td>Retrospective study</td>
<td>Prescribing</td>
<td>An error was defined as the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim. Prescription errors - defined as either an error in writing the prescription, or in the prescribing decision, which may impair effectiveness of treatment administration or have potential for harming a patient</td>
<td>1.8 errors from 2011 prescribed items collected giving an error rate of 0.09% per 100 items (95% CI 0.5 - 6.1%). Most common errors related to directions with an error rate of 2.8 per 100 items (95% CI 2.6 - 3)</td>
</tr>
<tr>
<td>Nori et al (2011)</td>
<td>2011</td>
<td>USA</td>
<td>Outpatient computer-generated prescriptions across three states</td>
<td>Retrospective review of computer-generated prescriptions received by commercial outpatient pharmacies in three states over 4 weeks</td>
<td>Retrospective cohort study</td>
<td>Prescribing</td>
<td>Prescriptions errors - corrections on prescriptions that required active interventions by pharmacists</td>
<td>Prescribing error rate = 12.7% of prescriptions, of which 35% had potential for harm. (6 in 30 computer-generated prescriptions included at least one error, of which one had potential for harm). Error rates varied by computerized prescribing system, from 5.1% to 37.5% (deterioration uncertain)</td>
</tr>
<tr>
<td>Ransman et al (2003)</td>
<td>2003</td>
<td>Australia</td>
<td>Representative sample of general practices, and community pharmacies patient records</td>
<td>Retrospective review of national data achieved on 1,000 GP with 100,000 annual consultations and 1,000 high-risk patients from pharmacists’ case notes over a 1 year period</td>
<td>Retrospective study</td>
<td>Prescribing</td>
<td>Medication incident - an event or circumstance associated with medication use that could have, or did lead to unintended and/or unnecessary harm to a person.</td>
<td>Adverse event rate 0.89% of ‘incident’ or (prescriber contact in 1996-2000); of these, 43% were ADR (i.e. not solely due to medication error). Medication error rate was not reported, and was difficult to calculate</td>
</tr>
<tr>
<td>Sayes et al (2009)</td>
<td>2009</td>
<td>Ireland</td>
<td>28 general practitioners and 12 community pharmacies</td>
<td>Retrospective analysis prescriptions presented to community pharmacies over a 3-day period</td>
<td>Prospective study</td>
<td>Prescribing</td>
<td>Prescription error detected by community pharmacies requiring intervention prior to dispensing</td>
<td>Prescribing error rate = 12.4% (prescriptions 93/840) or 2.9% (56/840); 2.4% errors were serious</td>
</tr>
<tr>
<td>Shafi et al (2001)</td>
<td>2001</td>
<td>UK</td>
<td>3 community pharmacies and 3 general practitioners located near the pharmacies</td>
<td>Retrospective analysis prescriptions from 35 doctors (three general practitioners) presented to three community pharmacies over the course of two months</td>
<td>Retrospective study</td>
<td>Prescribing</td>
<td>Prescription error detected by community pharmacies requiring pharmacist intervention prior to dispensing including administrative and legal errors (excluding medicines usually used as ‘directed’ and unlicensed indications)</td>
<td>Prescription error rate of 7.46 per 100 items (95% CI 7.2 - 7.8). Errors were found in 145 of the 1,373 handwritten items, presented during the study period (10.2%) compared with 1,233 of the 43,772 computer-generated items (7.7%) (A-squared = 0.05, chi-squared = 0.45, df = 1, P = 0.5001)</td>
</tr>
<tr>
<td>O’Shea and Dean Franklin (2007)</td>
<td>2007</td>
<td>UK</td>
<td>11 community pharmacies</td>
<td>Direct observation of dispensed items awaiting receipt by or delivery to patient</td>
<td>Prospective study</td>
<td>Dispensing, Transcribing</td>
<td>Any unintended deviation from an interpretative written prescription or medication order. Both content and labelling errors were included. Any Content error rate = 1.7%, Labelling error rate = 1.6% (Dispensed Items)</td>
<td>Any unintended deviation from professional or regulatory references, or guidelines affecting dispensing procedures, was also considered a dispensing error</td>
</tr>
<tr>
<td>Scarpure et al (2011)</td>
<td>2009/2010</td>
<td>UK</td>
<td>A cohort of 145 older residents in 13 care homes (9 residents, 4 nursing)</td>
<td>Dosing observation technique using pharmacy-managed barcode medication administration system, EMA</td>
<td>Administration</td>
<td>Medication administration error rate of 1.2% of total barcode medication administration episodes; 56% residents were exposed to MAN during the 6-month study period; each resident was exposed to 6.4 potential MANs</td>
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<tr>
<td>Marwaha et al (2009)</td>
<td>2006</td>
<td>US</td>
<td>Outpatient computer-generated prescriptions (expressions) in five states</td>
<td>Participating pharmacists documented active interventions on prescriptions</td>
<td>Prospective study</td>
<td>Prescribing</td>
<td>Prescriptions errors - corrections on prescriptions that required active interventions by pharmacists</td>
<td>Error rate = 3.8% prescriptions (102 interventions of 2,680 prescriptions)</td>
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