Pneumonia following antipsychotic prescriptions in electronic health records: a patient safety concern?

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ABSTRACT

Background

In screening the Intercontinental Medical Statistics (IMS) Health Disease Analyzer database of GP records from the UK, an increased registration of pneumonia subsequent to the prescription of some antipsychotic medicines was identified.

Aim

To investigate the temporal pattern between antipsychotic prescriptions and pneumonia with respect to age, type of pneumonia and other chest infections, and antipsychotic class.

Design of study

Self-controlled cohort analysis.

Setting

Electronic health records from the UK IMS Health Disease Analyzer database.

Method

Three groups of pneumonia-related International Classification of Diseases (ICD)-10 terms and prescriptions of atypical and conventional antipsychotic medicines were studied. Separate analyses were carried out for patients aged ≥65 years. The observed rate of pneumonia terms registered in different time periods in connection to antipsychotic prescriptions was contrasted to the overall rate of pneumonia terms relative to prescriptions of other drugs in the same dataset.

Results

In patients aged ≥65 years, an increased registration of a group of terms defined as 'acute chest infections', after atypical antipsychotic prescriptions, was identified. The corresponding increase after conventional antipsychotic prescriptions was much smaller. Bronchopneumonia had a striking increase after both atypical and conventional antipsychotic prescriptions, and was commonly recorded with fatal outcome. Few registrations of hypostatic pneumonia were noted. Patients aged <65 years did not have a higher rate of acute chest infections after receiving antipsychotic prescriptions.

Conclusion

The consistent pattern of an increased rate of chest infections after atypical antipsychotic prescriptions in older people seen in this outpatient study, together with the higher risk shown in a previous study on hospitalised patients, suggests a causal relationship. This is of importance since bronchopneumonia seems highly linked to fatal outcome. In the absence of a mechanism, further investigation of the role of antipsychotics in older people is needed.

Keywords

aged; antipsychotic agents; computerised medical records systems; pneumonia.

INTRODUCTION

Pneumonia can result in serious consequences, particularly in patients who are old and frail. The higher risk of death in older patients with dementia using antipsychotic medicines,[1–2] shown in meta-analyses on placebo-controlled studies was, apart from heart-related events, due to infections such as pneumonia.[1,3] These publications did not reveal details of pneumonia rates, comparing antipsychotic and placebo treatments.

Infections (mostly pneumonia) were the reason for non-cancer mortality in 10% of new users of antipsychotics in a large database cohort study on older people and, compared with users of atypical antipsychotics, the group using conventional antipsychotics showed a higher incidence (although not statistically significant) of pneumonia-related

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mortality.[4] A US study of users of antipsychotics who were admitted to the hospital for pneumonia showed a higher mortality rate for those who used conventional, rather than atypical, antipsychotics.[5] Antipsychotic use — in the case of the conventional group — among patients with Alzheimer's disease has shown to be a risk factor for aspiration pneumonia due to a noted drug effect on the swallowing reflex.[6]

Older patients currently using antipsychotic medicines, when compared with those not currently using them, were noted to be at higher risk for pneumonia with an adjusted odds ratio of 1.6 (95% confidence interval [CI] = 1.3 to 2.1) in a nested case control study on pharmacy dispensing and hospital discharge registrations.[7] Users of atypical antipsychotics showed a higher risk for pneumonia than users of conventional antipsychotics.

In prescribing information of antipsychotic drugs,[8] pneumonia is most often described in connection with the increased risk of death in older people with dementia, or listed as aspiration pneumonia. Further details of pneumonia in association to antipsychotic use are limited.

When screening the Intercontinental Medical Statistics (IMS) Health Disease Analyzer database of GP records from the UK, a finding that pneumonia was registered more frequently than expected after the introduction of risperidone prompted further investigation of the temporal pattern between any antipsychotic drug prescription and pneumonia-related terms, particularly in patients aged ≥65 years.

How this fits in

A previous study showed an increased risk of pneumonia in older patients currently using antipsychotic drugs in the Netherlands, based on prescription data and hospital discharge records. The current analysis offers a unique possibility to view patterns in records of pneumonia and other chest infections, both before and after antipsychotics were prescribed, in outpatient general practice. In patients aged ≥65 years, an increased registration of chest infections subsequent to the prescription of atypical antipsychotics was noted, relative to the rate in the same patients preceding the prescription.

METHOD

The UK IMS Health Disease Analyzer dataset used contained information of prescriptions and medical records of more than 2 million patients from different GP practices in the UK. Medical problems and notes are coded on entry by the GP using Read Codes. These Read Codes are mapped by IMS Health to the International Classification of Diseases (ICD)-10 terminology and defined in this analysis as 'medical events'. Data quality is maintained by the presence of data-quality markers in the database; collated information from the markers is used to feed back to GPs, which helps maintain and improve data quality in the database.[9]

The pattern-discovery method for longitudinal patient records, previously described in Norén *et al,*[10] was applied on the UK IMS Health Disease Analyzer dataset as of 1 January 2006. The method contrasts the observed rate of registration of a medical event (here a pneumonia-related ICD-10 term) in various time periods relative to the prescription of a drug (here antipsychotics), to the overall registration rate of the same medical event, relative to prescriptions of other drugs in the same data. For each time period of interest (the results presented are for monthly intervals), a measure of association — referred to as the Information Component (IC) — is computed. This indicates whether the medical event is registered unexpectedly frequently (IC>0), unexpectedly rarely (IC<0) or as often as can be expected (IC = 0) in a given time period, based on the overall registration rate for the event relative to other drugs.

A graphical representation of the IC values, along with observed and expected numbers of events in different time periods, provides an overview of the temporal relationship between two events; this is referred to as a chronograph. To screen for patterns of temporal association, an IC_{Δ} value is computed that contrasts the IC value in the month immediately after a prescription with the IC value in a 6-month control period centred 2 years prior. For both IC and IC_{Δ}, a combination of statistical shrinkage and uncertainty intervals is used to reduce the risk of highlighting spurious associations. The lower limit of the 95% credibility interval is referred to as IC_{025} for the IC and as $IC_{\Delta 025}$ for IC_{Δ}.

To avoid dominance of repeat prescriptions, the analysis was restricted to new prescriptions of the antipsychotic medicine, defined as the first record of the drug prescription over a course of 13 months. Drugs within the European Pharmaceutical Market Research Association's anatomical classification of pharmaceutical products[11] — the atypical (N05A1) and conventional antipsychotic (N05A9) groups — were used. The pneumonia-related ICD-10 terms were grouped and will be referred to in this article as follows:

- 'acute chest infections' (ICD codes J110, J12x-16x, J181, 188, 189, J220);
- bronchopneumonia (J180); and
- 'hypostatic pneumonia' (J182, J69x).

The acute chest infections group was defined as being rather inclusive, for example, as for 'unspecified acute lower respiratory infection' (J220). Graphs labelled 'pneumonia and other chest infections' include all ICD-10 terms used in this study.

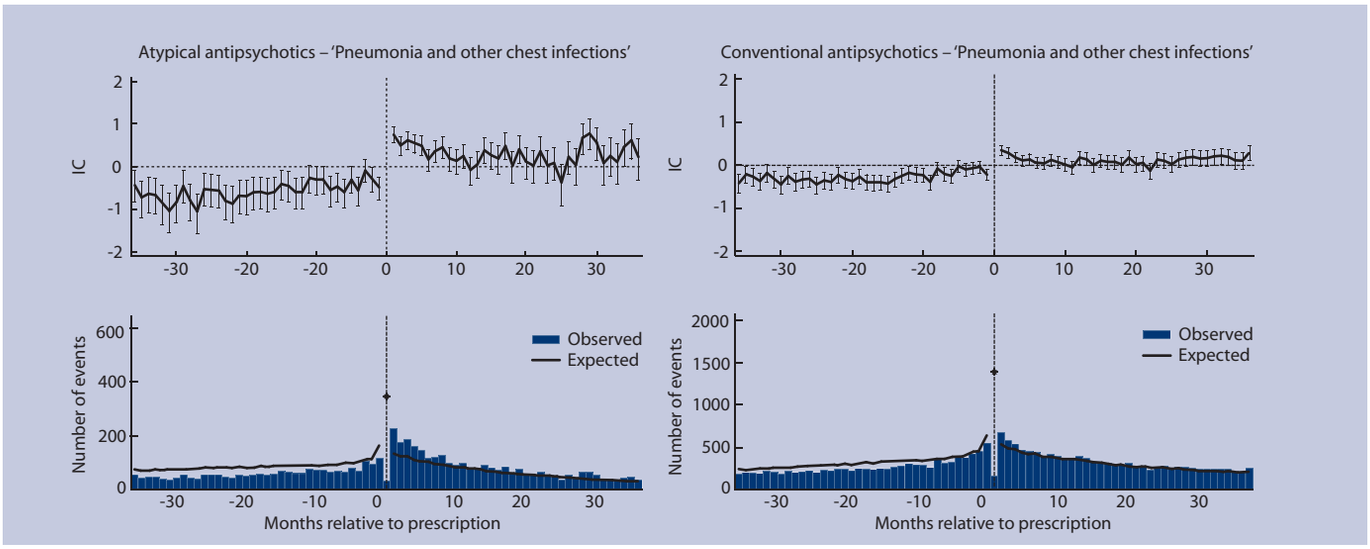


Figure 1. Chronographs for records of 'pneumonia and other chest infections' relative to atypical and conventional antipsychotic prescriptions for all ages. IC value on the day (month = 0) for the IC graph was below –2 and outside the scale.

Appendices 1, 2 and 3 give a complete listing of all the ICD-10 codes with the names specified, as well as the linked Read Codes within each group of ICD-10 codes that were used in the search. The age groups used were 18–64 years and ≥65 years.

Details of the patients linked with pneumonia-related terms that were recorded within the month after an atypical or conventional antipsychotic prescription were also reviewed.

RESULTS

Pneumonia and other chest infections over time: chronographs

The figures with chronographs display monthly registrations of the different pneumonia-related term groupings, 3 years before and after atypical and conventional antipsychotic prescriptions. The lower panel of the figure displays a graphical overview of the observed and expected numbers of pneumonia registrations in different time periods relative to the antipsychotic prescription; the upper panel shows the corresponding relative rate with IC values.

Figure 1 shows the temporal pattern for 'pneumonia and other chest infections' recorded relative to atypical and conventional antipsychotic prescriptions for all ages. A sudden increase in the recording rate of pneumonia-related terms was noted after an antipsychotic prescription, compared with the period prior to prescription. Compared with patients with other prescriptions, a higher relative recording rate of the pneumonia-related terms was noted after antipsychotic prescriptions.

Figure 2 displays the chronographs for acute chest infections recorded before and after atypical and conventional antipsychotic prescriptions for patients aged ≥65 years. The corresponding result for patients aged 18–64 years is shown in Figure 3. For patients aged ≥65 years, there was an unexpectedly higher relative rate of terms within the acute chest infections group, recorded after atypical

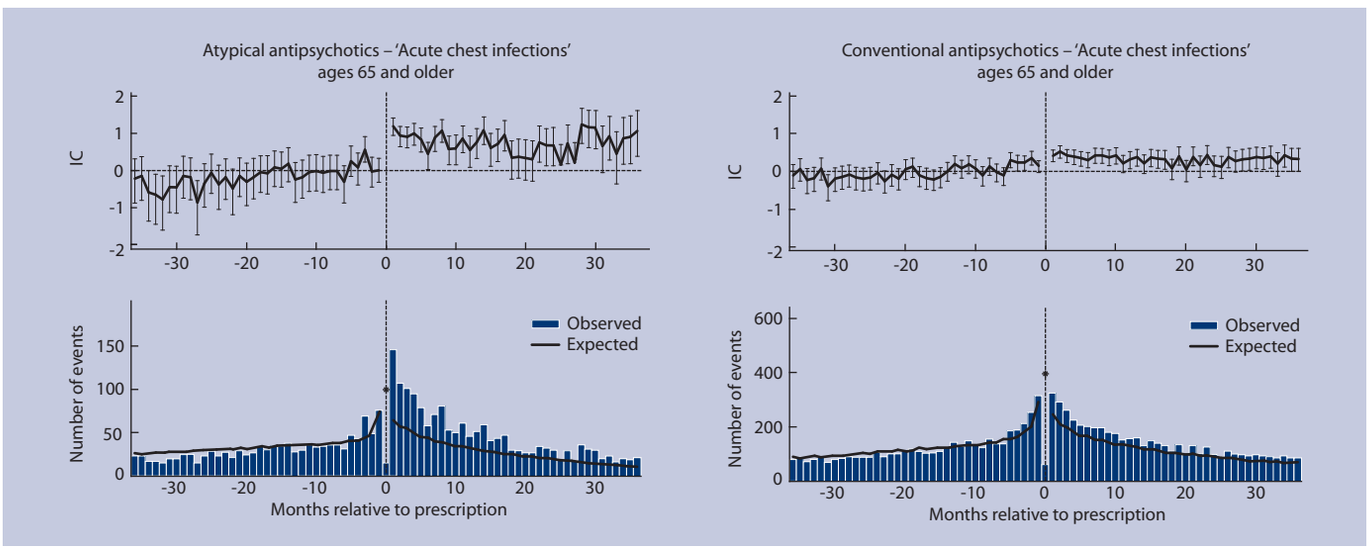
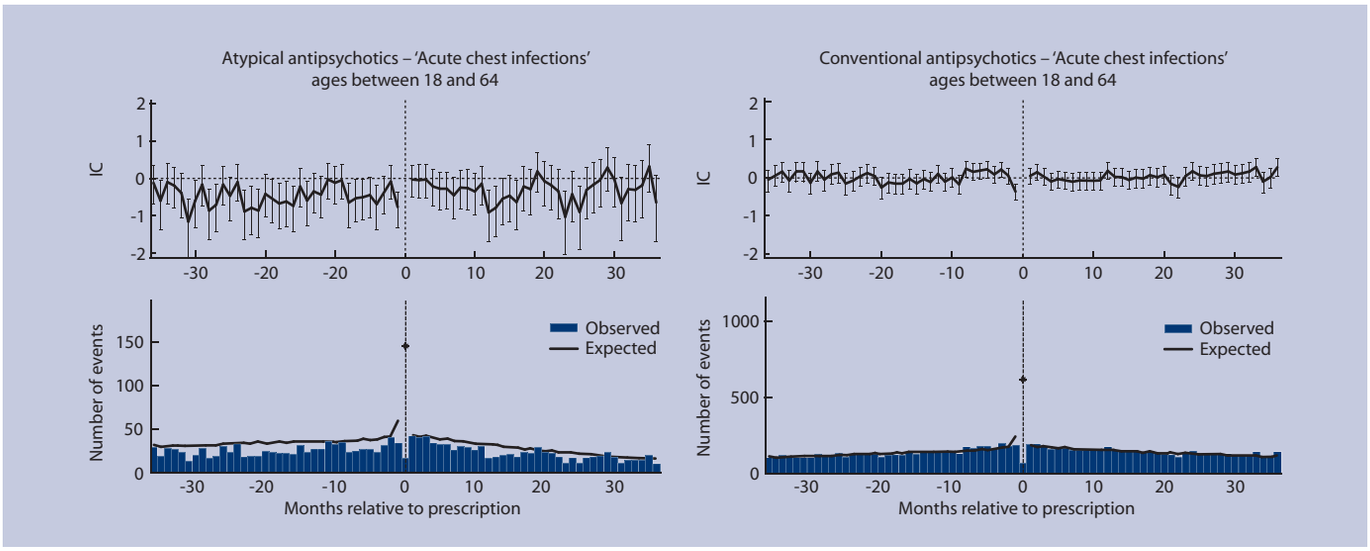


Figure 2. Chronographs for records of acute chest infections relative to atypical and conventional antipsychotic prescriptions for ages ≥65 years. IC value on the day (month = 0) for the IC graph was below –2 and outside the scale.



antipsychotic prescriptions, compared with before. For the conventional antipsychotics, the difference of acute chest infections before and after prescription was much smaller.

The temporal pattern for bronchopneumonia in patients aged ≥65 years was similar for atypical and conventional antipsychotic prescriptions, with a relative increase of registrations in the month after prescription, continuing for several months (Figure 4). In the years preceding the antipsychotic prescription, there were few registrations of bronchopneumonia, resulting in a fluctuating relative rate, although for the conventional antipsychotics the relative rate had already been increasing before prescription took place.

The hypostatic pneumonia group, including aspiration pneumonitis, had few registrations of this category, particularly in the atypical antipsychotic group (Figure 5). The conventional antipsychotics had an elevated relative rate on day of prescription that continued at a similar level during the months after prescription.

The temporal patterns between the antipsychotics and the pneumonia-related terms, as seen in the above analyses, remained also when limiting the data to patients aged ≥80 years.

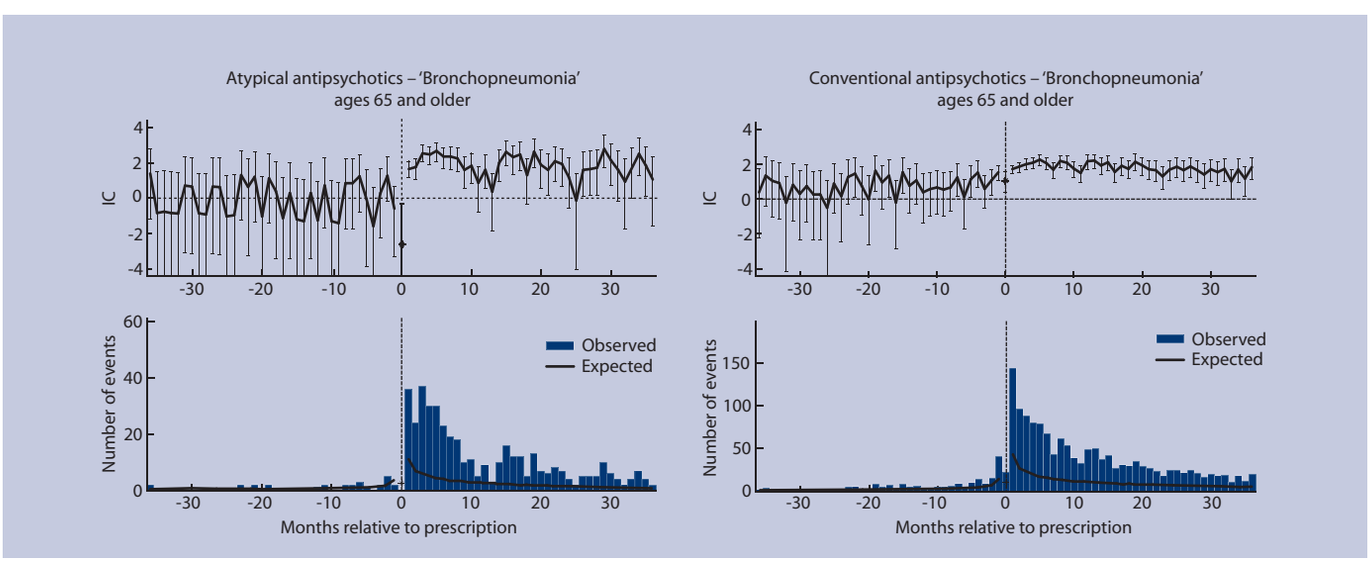
An increase of amoxicillin prescriptions was seen after atypical antipsychotic prescriptions, confirming the temporal pattern seen for acute chest infections subsequent to the same antipsychotic class (Figure 6). This was not seen for the conventional antipsychotics.

Figure 3. Chronographs for records of acute chest infections relative to atypical and conventional antipsychotic prescriptions for ages 18–64 years. IC value on the day (month=0) for the IC graph was below –2 and outside the scale.

Review of patients aged ≥65 years with pneumonia-related terms recorded within the month after an antipsychotic prescription

The account of details in this section regards the prescriptions for patients aged ≥65 years who had a pneumonia-related term recorded within the month after the antipsychotic prescription. The type and number of atypical and conventional antipsychotic

Figure 4. Chronographs for records of bronchpneumonia relative to atypical and conventional antipsychotic prescriptions for ages ≥65 years.



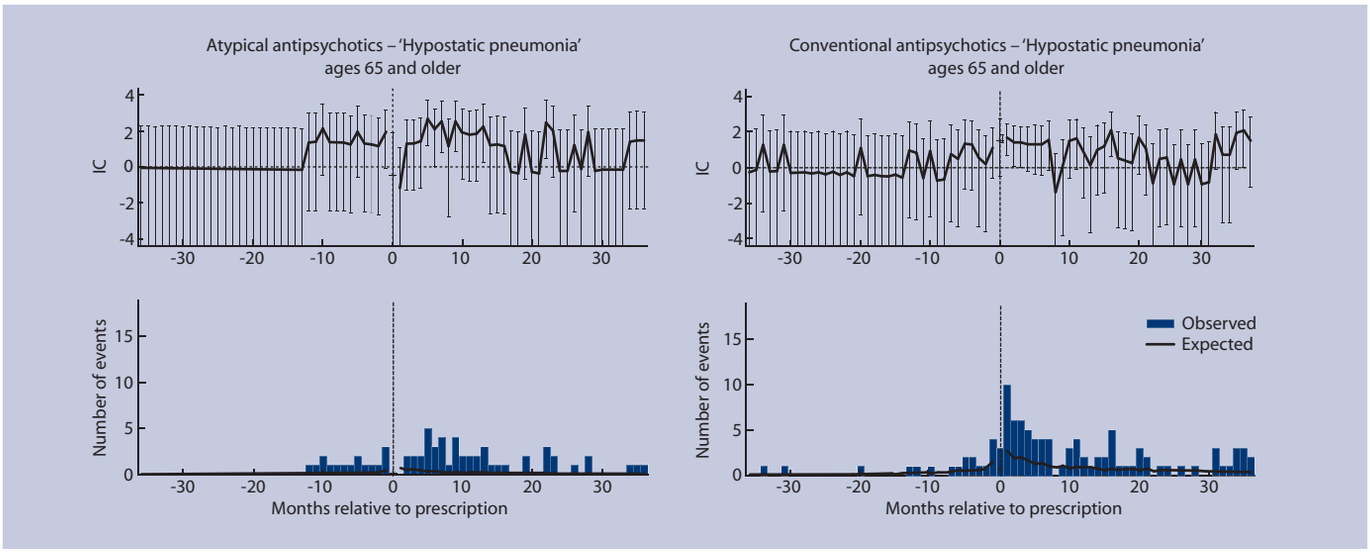


Figure 5. Chronographs for records of hypostatic pneumonia relative to atypical and conventional antipsychotic prescriptions for ages ≥65 years.

prescriptions represented in each antipsychotic class for this group of patients is given in Table 1. The atypical and conventional antipsychotic prescriptions were, to a large extent, represented by risperidone and thioridazine respectively, which were also the top prescribed antipsychotics in the dataset.

The ICD-10 term that was mostly represented within the acute chest infections group in the month after prescription was 'unspecified acute lower respiratory infection' for both atypical and conventional antipsychotics (Table 2).

The median age for patients aged ≥65 years with registrations of acute chest infections terms in the month after atypical and conventional antipsychotic prescription was 85 and 83 years, respectively. The corresponding median age for bronchopneumonia was 83.5 years for atypical prescriptions and 84 years for conventional antipsychotic prescriptions.

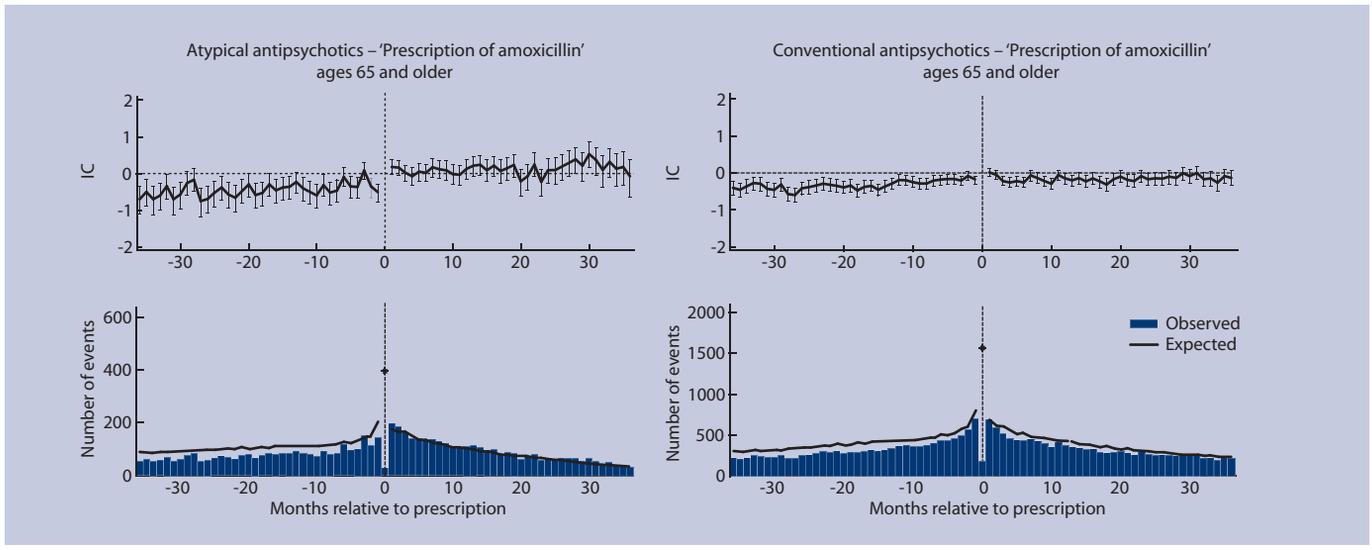
To increase understanding of the outcomes in the patients (≥65 years) who had acute chest infections and bronchopneumonia in the month after prescription, the rate of deregistrations in these patient histories were reviewed from time of antipsychotic prescription until the end of the month. A total of 86% of the patients with bronchopneumonia were deregistered within the month after an atypical antipsychotic prescription. The corresponding percentage for the patients with conventional antipsychotic prescriptions was 71%. The deregistration rate for patients with acute chest infections was 15% within the month after an atypical prescription and 20% after a conventional antipsychotic prescription. Death was the most common reason for deregistration.

DISCUSSION

Summary of main findings

In patients aged ≥65 years, an increased registration of acute chest infections subsequent to atypical

Figure 6. Chronographs for the prescription amoxicillin relative to atypical and conventional antipsychotic prescriptions for ages ≥65 years.



antipsychotic prescriptions was noted relative to the rate in the same patients prior to the prescription. An increased rate of acute chest infections was seen also relative to the background of older people having been prescribed other medications. The corresponding increase after conventional antipsychotic prescriptions was much smaller. Patients aged <65 years did not have a higher rate of chest infections after antipsychotic prescriptions, be they atypical or conventional.

Bronchopneumonia had a striking and persistent increase in the follow-up period after both atypical and conventional antipsychotic prescriptions. There was, however, an increase in the relative rate of bronchopneumonia before conventional antipsychotic prescriptions. Registrations of bronchopneumonia subsequent to antipsychotic prescriptions were also highly associated with records indicating death.

An elevated rate of registrations was noted for hypostatic pneumonia around the time of conventional antipsychotic prescriptions. This group of terms had few registrations, particularly for atypical prescriptions, making the evaluation more uncertain.

Strengths and limitations of this study

The recorded diagnosis of pneumonia and related terms in this study of electronic health records is based on clinical evidence and not confirmed by radiological, or any other, tests. The study is dependent on the codes assigned by GPs and could be subject to misclassification bias. As for any study based on issued prescription records, it is not known if the patient actually took the medication prescribed. Observational data will commonly be unsatisfactory, to various degrees, because it is not collected for a specific research reason; on the other hand, it reflects the way normal clinical practice is done, rather than ideal interventions, which may not be generalisable.

Due to the dataset used in this study, the results do not represent all types of antipsychotic drugs. Some antipsychotics dominated more than others and some drugs, such as clozapine, had very few prescriptions. Thioridazine was noted to be a commonly prescribed conventional antipsychotic in this data; however, this drug has been withdrawn in many countries, including the UK, due to its adverse cardiac effects.[12] However, when this drug was excluded from the analysis it made no difference to the overall results. It is also important to consider the heterogeneity of the various drugs represented within the atypical and conventional antipsychotic classes in this study, as well as the limitations of using the current groupings of antipsychotic drugs as highlighted by Leucht *et al*.[13]

Table 1. Number and type of atypical and conventional antipsychotic prescriptions with a pneumonia-related term recorded in the month after prescription, ages ≥65 years.

	Acute chest infections	Bronchopneumonia	Hypostatic pneumonia
Atypical antipsychotics			
Risperidone	103	27	0
Olanzapine	25	9	0
Quetiapine	16	0	0
Amisulpride	2	0	0
Total atypical	146	36	0
Conventional antipsychotics			
Thioridazine	117	62	3
Haloperidol	77	37	3
Promazine	37	8	2
Chlorpromazine	30	17	1
Trifluoperazine	22	2	1
Flupentixol	17	3	0
Sulpiride	10	2	0
Levomepromazine	5	8	0
Zuclopenthixol	4	1	0
Droperidol	3	1	0
Perphenazine	2	1	0
Benperidol	2	0	0
Fluphenazine	0	1	0
Fluspirilene	0	1	0
Total conventional	326	144	10

Table 2. ICD-10 terms for patients in the 'acute chest infections' group recorded in the month after antipsychotic prescription, ages ≥65 years.

ICD-10 terms following antipsychotic prescriptions	Atypical prescriptions	Conventional prescriptions
Unspecified acute lower respiratory infection	125	281
Pneumonia, unspecified	15	31
Influenza with pneumonia, virus not identified	3	2
Viral pneumonia, unspecified	1	3
Pneumonia due to *Streptococcus pneumoniae*	1	5
Other bacterial pneumonia	1	1
Lobar pneumonia, unspecified	–	2
Bacterial pneumonia, unspecified	–	1

ICD = International Classification of Diseases.

The most commonly recorded ICD-10 term within 'acute chest infections' concerned 'unspecified acute lower respiratory infection', which is a commonly used term overall; this dominated the other terms included in the group.

The duration of the antipsychotic prescriptions has not been considered in the graphical display of pneumonia-related medical-event registrations; hence, in cases of late onset, the patient may not have been a current user of the medicine when the event occurred.

Records of fatal outcome obviously cannot precede prescription. As such, cautious interpretation is needed when comparing the 'before' and 'after' prescription pattern of medical events

most commonly associated with fatal outcome, as shown for bronchopneumonia.

A case-by-case evaluation to determine the possible causal relationship between the drug and the recorded event for individual patients has not been done in this study, and co-recorded events or prescriptions have not been evaluated. Instead, this analysis offers a way to highlight overall patterns of records before and after prescription, accounting for biases like expected clusters of events around prescriptions in general.

Without further analysis, it is not possible to identify any causative mechanism or factor leading to chest infections among older people who have been prescribed an antipsychotic drug. However, this study shows the temporal recording pattern of pneumonia and other acute chest infections in outpatients, not only after prescription but also before, sharpening the picture of the course of events in these patients.

Comparison with existing literature

The higher rate of chest infections after prescription of atypical antipsychotics is in line with Knol *et al*'s study,[7] where a stronger association between atypical antipsychotics and pneumonia was also seen, as compared with conventional antipsychotics. Users of conventional antipsychotics had a higher risk of death from infections, including pneumonia, than users of atypical antipsychotics in Setoguchi *et al*'s study,[4] but the difference was not statistically significant. A comparison with this study is complicated, given that different conventional antipsychotics are dominant in Setoguchi *et al*'s study, and because they investigated mortality while the current study examined pneumonia-related terms, irrespective of outcome. Loxapine was the most commonly prescribed conventional antipsychotic in Setoguchi *et al*'s study,[4] whereas thioridazine was the most commonly prescribed conventional antipsychotic in the current dataset, with loxapine being a rarely prescribed drug.

Drug effects, possibly leading to pneumonia after antipsychotic prescriptions, in older people were reviewed by Knol *et al*.[7] They mention xerostomia, dysphagia, dyskinesia, and sedation, which could result in swallowing problems, thereby causing aspiration pneumonia. In the current study there were few registrations specifically stating diagnoses suggestive of aspiration. However, it is plausible that GPs used a more general pneumonia term to record consequences of aspiration. Granulocytopenia is another disorder possibly caused by antipsychotics that could lead to a greater susceptibility of infection, resulting in the development of pneumonia. However, the increases in rates of serious acute chest infections soon after first use of an antipsychotic seen in this analysis are unlikely to be due to granulocytopenia, as (after first exposure) it takes some time to develop, and the infection occurs at an even later date.

The occurrence of acute chest infections after the prescription of antipsychotics in the present study could also be explained by other events and need not be a direct effect of the antipsychotic medicine. Pneumonia in older people may present with sudden psychiatric disturbances, such as confusion, agitation, or psychosis, while fever may not be prominent.[14] In such patients, antipsychotics may be prescribed when the infection is not recognised,[7] or to help manage the patient if it is. Likewise, in such patients, both the use of antipsychotics and serious illness and death would be more likely to occur. Confounding possibilities also exist for psychiatric disorders and pneumonia in older people in primary care situations, such as neoplasia with cerebral secondaries, self neglect, alcoholism, and more.

Bronchopneumonia was commonly recorded in connection to fatal outcome in this study, and death often occurred in the first weeks of antipsychotic use among the subset of older people studied more in detail. A Swedish study on autopsy reports revealed that far more patients with a terminal illness and dementia died from bronchopneumonia (38.4%) than older people in general (2.8%).[15] This might explain why bronchopneumonia is recorded in temporal association with antipsychotic prescriptions given for patients with dementia, and could be seen as a natural course of their disease. However, it is interesting that the recording of bronchopneumonia commences so soon after first prescriptions of antipsychotic medicines, as seen in this study.

Implications for future research

As this study on outpatient records with chest infections following atypical antipsychotic prescriptions in older people confirms Knol *et al*'s study on hospitalised patients,[7] a causal relationship seems suggestive. Such an association would be of particular importance to patients with bronchopneumonia, as this diagnosis seems highly connected to fatal outcome. In the absence of a mechanism, further investigation of the role of antipsychotics in older people is needed.

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Competing interests

Kristina Star has stocks in AstraZeneca. All other authors declare they have no competing interest relevant to this study.

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Appendix 1. ICD terms and Read Codes[a] for 'acute chest infections'.

ICD-10 code	ICD-10 term	Read Code	Read term
J110	Influenza with pneumonia. Virus not identified	.H3..	Pneumonia and influenza
		.H351	Influenza + pneumonia
		.H3Z.	Pneumonia/influenza NOS
		H270.	Influenza + pneumonia
		H2700	Influenza + bronchopneumonia
		H270z	Influenza + pneumonia NOS
		H2y..	Pneumonia or influenza OS
J120	Adenoviral pneumonia	H200.	Pneumonia — adenovirus
J121	Respiratory syncytial virus pneumonia	H201.	Pneumonia — resp.syncyt.virus
J128	Other viral pneumonia	H20y.	Pneumonia — virus NEC
J129	Viral pneumonia, unspecified	.H31.	Viral pneumonia
		H20..	Viral pneumonia
		H20z.	Viral pneumonia NOS
J130	Pneumonia due to streptococcus pneumoniae	.H32.	Lobar-pneumococcal — pneumonia
		H21..	Lobar (pneumococcal) pneumonia
J140	Pneumonia due to haemophilus influenzae	H222.	Pneumonia — H.influenzae
J150	Pneumonia due to klebsiella pneumoniae	H220.	Pneumonia — klebsiella pneum.
J151	Pneumonia due to pseudomonas	H221.	Pneumonia — pseudomonas
J152	Pneumonia due to staphylococcus	H224.	Pneumonia — staphylococcal
J154	Pneumonia due to other streptococci	H223.	Pneumonia — streptococcal
J156	Pneumonia due to other aerobic Gram-negative bacteria	H22yX	Pneumn/o aerobc grm-ve bact
J157	Pneumonia due to mycoplasma pneumoniae	.H342	Mycoplasma pneumonia
		H231.	Pneumonia — mycoplasma pneumon
		H232.	Pneumonia — PPLO
		H28..	Atypical pneumonia
J158	Other bacterial pneumonia	H22..	Other bacterial pneumonia
		H22y.	Pneumonia — other specif.bact.
J159	Bacterial pneumonia, unspecified	.H341	Bacterial pneumonia NOS
		H22yz	Pneumonia — bacteria NOS
		H22z.	Bacterial pneumonia NOS
J160	Chlamydial pneumonia	H233.	Chlamydial pneumonia
J168	Pneumonia due to other specified infectious organisms	H23..	Pneumonia — specif.organisms
		H23z.	Pneumonia—spec.organism NOS
J181	Lobar pneumonia, unspecified	H260.	Lobar pneumon-unspec organism
		H2600	Lung consolidation
		H261.	Basal pneumon-unspec organism
J188	Other pneumonia, organism unspecified	Hyu0H	[X]Oth pneumonia,organsm unspf
		H20y0	Severe acute respiratory syndr
J189	Pneumonia, unspecified	.H34.	Pneumonia NOS
		.H34Z	Pneumonia NOS
		H2...	Pneumonia and influenza
		H24..	Pneumonia + Infect.disease EC
		H26..	Pneumonia, organism unspecif.
		H262.	Postoperative pneumonia
		H2z..	Pneumonia or influenza NOS
		.H346	Bilateral pneumonia
J220	Unspecified acute lower respiratory tract infection	.H1..	Acute respiratory infections
		.H163	Acute low respitract infection
		.H1Z.	Acute resp. infection NOS
		.H6ZA	Chest infection NOS
		.H6ZB	Lower respiratory tract infect
		H0...	Acute respiratory infections
		H062.	Acute low respitract infection
		H06z0	Chest infection NOS
		H06z1	Lower resp tract infection
		H06z2	Recurrent chest infection
		H0y..	Acute respiratory infectns.OS
		H0z..	Acute respiratory infectn.NOS
		SP132	Post operative chest infection

[a]*GP 4-byte set and 5-byte set Read Codes. ICD = International Classification of Diseases.*

Appendix 2. ICD terms and Read Codes[a] for bronchopneumonia.

ICD-10 code	ICD-10 term	Read Code	Read term
J180	Bronchopneumonia, unspecified	.H33.	Bronchopneumonia
		H25..	Bronchopneumonia,organism unsp

[a]GP 4-byte set and 5-byte set Read Codes. ICD = International Classification of Diseases.

Appendix 3. ICD terms and Read Codes[a] for 'hypostatic pneumonia'.

ICD-10 code	ICD-10 term	Read Code	Read term
J182	Hypostatic pneumonia, unspecified	.H6Z4	Hypostatic bronchopneumonia
		H5400	Hypostatic pneumonia
		H5401	Hypostatic bronchopneumonia
J690	Pneumonitis due to food and vomit	.H53.	Aspiration pneumonia
		H470.	Pneumonitis-food/vomit inhal.
		H4703	Pneumonitis-vomitus inhalation
		SP131	Other asp.pneumonia after care
J691	Pneumonitis due to oils and essences	H471.	Pneumonitis-oil/essence inhal.
		H4710	Lipoid pneumonia (exogenous)
J698	Pneumonitis due to other solids and liquids	H47..	Pneumonitis - solids/liquids
		H47y.	Pneumonitis-other solid/liquid
		H47yz	Pneumonitis-solid/liquid NOS
		H47z.	Pneumonitis-solid/liquid NOS

[a]GP 4-byte set and 5-byte set Read Codes. ICD = International Classification of Diseases.