

Prescription pattern and appropriateness of antibiotics in the management of cough/cold or respiratory disorders

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Abstract

Objective: This study aims to assess the prescribing patterns and appropriateness of antibiotics in treating cough/cold and diarrhea in children. Given that infants and children are highly vulnerable to illnesses, the objective focuses on analyzing the types and appropriateness of antibiotics prescribed by healthcare professionals.

Methods: The study involved analyzing the prescriptions of pediatric patients diagnosed with cough, cold, respiratory, and gastrointestinal diseases. The analysis focused on the types of drugs, particularly antibiotics, prescribed for these conditions.

Results: The study found that baby girls are more susceptible to colds and coughs than boys, with infants aged 0 to 2 being particularly affected, likely due to improper care and winter exposure. Respiratory and gastrointestinal issues emerged as the most prevalent health concerns among pediatric patients, with cough and cold accounting for 33.3% of cases, highlighting a significant issue with upper respiratory tract infections. A high frequency of antibiotic prescriptions was observed, especially cefixime and amoxicillin, which are often irrationally prescribed for viral infections like the common cold.

Conclusion: Respiratory and gastrointestinal disorders are the most common issues among pediatric patients, with upper respiratory tract infections being particularly prevalent. The study identified a concerning trend of irrational antibiotic prescriptions, especially for viral infections such as the common cold. The findings call for improved prescribing practices to ensure antibiotics are used appropriately and only when necessary, emphasizing the need for evidence-based treatments to enhance patient safety and public health outcomes

Keywords: Antibiotics; Prescription; Cough; Cold; Antimicrobial resistance etc

1. Introduction

There are different categories of the drugs play an important role in protecting, maintaining and restoring health of a living body. Among these different population groups, infants and children are the most vulnerable groups to contact illnesses. Among the drugs Antibiotics are the most lifesaving drugs. [1, 2].

Antibiotics exhibit either cytotoxic or cytostatic effects on microorganisms, thereby facilitating the eradication of such pathogens through the mechanisms of the host's innate and adaptive immune responses. Frequently, they exert their antimicrobial efficacy by obstructing the biosynthesis pathways of bacterial cell walls, proteins, deoxyribonucleic acid

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(DNA), and ribonucleic acid (RNA), employing membrane-disruptive agents, or through mechanisms of action that target specific cellular processes. Antibiotics can also get inside bacteria by sticking to their cell walls and using the bacteria's own energy systems to reach places where they make proteins. This then stops the bacteria from making the proteins they need to live [3].

This study looks at the ongoing and serious problem of antibiotic resistance, a major global health threat, and discusses ways to tackle it. Political efforts, new laws, development of new treatments, and education are all important to slow down the rise of antibiotic resistance. Finding ways to stop antibiotic resistance is a big challenge for scientists and public health experts. Over the past few decades, there has been a significant increase in bacteria that are resistant to one or more antibiotics worldwide [4].

Respiratory tract infections, a significant cause of morbidity and mortality in the paediatric age group in developed as well as developing countries [5]. Respiratory infections are common and frequent diseases and present one of the major complaints in children and adolescents [6]. Recent evidence shows that broad-spectrum antibiotic prescribing has increased and frequently occurs when either no therapy is necessary, Recent evidence shows that broad-spectrum antibiotic prescribing has increased and frequently occurs when either no therapy is necessary [7].

Antimicrobial resistance (AMR) is when harmful bacteria can survive despite antibiotic treatment. This makes standard treatments ineffective, leading to longer and more serious illnesses, higher medical costs, and increased death rates. AMR happens due to various factors, but mainly because of bacterial mutations or acquiring resistance genes, often due to overusing or misusing antibiotics. Overuse means giving antibiotics for conditions that don't need them, like viral infections. Misuse involves prescribing the wrong type, dose, or duration of antibiotics. Several reasons for this problem include doctors' lack of knowledge, poor diagnostic systems, concern about future complications, and insufficient oversight and regulation [8, 9].

The study of prescribing pattern is a part of the medical audit and seeks to monitor, evaluate and if necessary, suggest modification in prescribing practices to make medical care rational and cost effective. Appropriate drug utilization in terms of efficacy, safety, convenience and economic aspects at all levels in the chain of drug use. The objective of this study was to assess the prescribing pattern and appropriateness of antibiotics prescribed in the treatment of cough/cold and/or diarrhea in children. The study of prescribing patterns is part of a medical review to monitor, evaluate, and suggest changes to make medical care more rational and cost-effective. It focuses on using drugs effectively, safely, conveniently, and economically.

2. Methodology

This was an observational, cross-sectional, questionnaire based study carried out in the department of Pharmacy, Jahangirabad Institute of Technology Faculty of Pharmacy, Barabanki UP., India.

A descriptive study was conducted for 3 months from March 2024 to June 2024. The study was carried out in inpatient paediatric units including Out Patient Department at rural and urban areas. Treatment cost is very low which attracts patients from nearby rural areas and referral from government dispensaries. Children from (0-10) years of age in outpatient department with symptoms of cough, cold and gastrointestinal disorders were recruited for this study.

Data were collected on a predesigned form on a daily basis. Content validity of the data collection form was performed. All the relevant data were collected by a thorough review of profiles, medication records, and other related notes.

2.1. Steps involved in methodology

- Collection of prescriptions: We have collected 1250 prescriptions from rural (Barabanki) as well as urban (Jahangirabad) areas of related to the antibiotics in the management of cough/cold, respiratory disease and gastrointestinal disorder in paediatrics.
- Screening the Prescriptions: After collection, we have screened out 1000 prescriptions related to recent work.
- Analysing the Data: In this, we examined the information contained in medical prescription. It involved that types of antibiotics were prescribed to the children and how antibiotics were being used related to the cough/cold and diarrhea in paediatrics patients.
- Statistics of Data: Obtaining data was organized and calculated, providing a comprehensive statistical summary."

3. Results

The table 1 provides a distribution of pediatric patients by gender. The data reveals that there are a total of 442 male patients and 468 female patients. This indicates that female patients slightly outnumber male patients in this dataset, with females comprising approximately 53% of the total pediatric population and males about 48%. The near-equal distribution suggests that both genders are nearly equally represented in the pediatric patient population, ensuring a balanced analysis across gender lines for any further medical or demographic studies.

Table 1 Types of gender of paediatrics patients

S.No.	Gender	No. of Patients	Percentage
1	Male	468	46.33%
2	Female	532	53.66 %

The table "Age Distribution of Pediatric Patients" highlights the number and percentage of pediatric patients across different age groups. The youngest age group, 0-2 years, has the highest representation with 369 patients, accounting for 41% of the total population. It was found that as the age increasing the number of patients were decreasing.

Table 2 Age groups of patients

S. No.	Age	No. of Patients	Percentage
1	0-2	369	41.00%
2	2-4	278	30.89%
3	4-6	134	14.89%
4	6-8	76	8.44%
5	8-10	43	4.78%

Based on the provided table no. 3, here are some observations:

The most common disease among the patients is "Cough," with 188 patients, which accounts for 18.8% of the total. The second most common disease is "Cold," with 145 patients, making up 14.5% of the total. "Loose Motion" is the third most common disease, affecting 123 patients (12.3%). "Abdominal Pain" has 72 patients, which is 7.2% of the total. "Constipation" affects 43 patients (4.3%). "Vomiting" is seen in 29 patients (2.9%). "Shortness of Breath" affects 6 patients (0.6%). The least common disease is "Nausea," with only 10 patients, accounting for 1.0% of the total.

Table 3 Reflected about the type of diseased based on the number of patients provided.

S. No.	Diseases	No of patients	Percentage (%)
1.	Cough	188	18.8%
2.	Cold	145	14.5%
3	Abdominal Pain	72	7.2%
4.	Loose Motion	123	12.3%
5.	Constipation	43	4.3%
6.	Vomiting	29	2.9%
7.	Nausea	10	1.0%
8.	Shortness of Breath	6	0.6%

It was observed that from the table no. 4

3.1. Most Commonly Prescribed antibiotics (AB)

"Cefixime," a cephalosporin, is the most frequently prescribed drug, with 161 prescriptions, accounting for 26.79% of the total. "Amoxicillin," a penicillin, is the second most commonly prescribed drug, with 155 prescriptions, making up 25.29% of the total. "Amoxyclav," penicillin, follows closely with 110 prescriptions (18.30%).

3.2. Moderately Prescribed AB

"Ofloxacin," a fluoroquinolone, has 44 prescriptions, which is 7.32% of the total. "Azithromycin," a macrolide, has 19 prescriptions, accounting for 3.16%. "Septron," a sulfonamide, has 14 prescriptions (2.33%).

3.3. Less Commonly Prescribed AB:

"Augmentin," "Moxikind," and "Mega-CV," all penicillins, have 8 (1.33%), 4 (0.67%), and 4 (0.67%) prescriptions respectively. "Norfloxacin" and "Ciprofloxacin," both fluoroquinolones, each have 6 prescriptions (0.1%). "Gudcef" and "Cefpodoxime," both cephalosporins, each have 3 prescriptions (0.50%).

3.4. Least Commonly Prescribed AB:

"Preclav," a Penicillin, is the least prescribed drug with only 5 prescriptions, accounting for 0.83% of the total.

3.5. Drug Categories

Penicillins are the most represented category with multiple drugs: "Amoxicillin," "Preclav," "Mega-CV," "Augmentin," "Moxikind," and "Amoxyclav." Cephalosporins also have significant representation with "Cefixime," "Gudcef," and "Cefpodoxime." Fluoroquinolones include "Norfloxacin," "Ciprofloxacin," and "Ofloxacin." Other categories like macrolides and sulfonamides are represented by "Azithromycin" and "Septron," respectively.

3.6. Dosage Forms

Most drugs are available in both tablet and syrup forms, indicating a consideration for different patient preferences or needs (e.g., children vs. adults). Only "Azithromycin" is exclusively available in tablet form.

Table 4 Types of antibiotics used for patients

S. No	Drug	Category	Frequency	Percentage (%)	Dosage Form
1.	Amoxicillin	Penicillin	155	25.29	Tablet, Syrup
2.	Cefixime	Cephalosporin	161	26.79	Tablet, Syrup
3.	Azithromycin	Macrolide	19	3.16	Tablet
4.	Norfloxacin	Fluoroquinolone	6	1.0	Tablet, Syrup
5.	Septron	Sulfonamide	14	2.33	Tablet, Syrup
6.	Preclav	Penicillin	5	0.83	Syrup
7.	Ciprofloxacin	Fluoroquinolone	6	1.0	Tablet, Syrup
8.	Ofloxacin	Fluoroquinolone	44	7.32	Tablet, Syrup
9.	Gudcef	Cephalosporin	3	0.50	Tablet, Syrup
10.	Mega-CV	Penicillin	4	0.67	Syrup
11.	Cefpodoxime	Cephalosporin	3	0.50	Tablet, Syrup
12.	Augmentin	Penicillin	8	1.33	Tablet, Syrup
13.	Moxikind	Penicillin	4	0.67	Tablet, Syrup
14.	Amoxyclav	Penicillin	110	18.30	Tablet, Syrup
15.	Gentamycin	Macrolide	7	1.15	Injection

Based on the provided table 5, here are the detailed observations:

The data reveals that Multivitamin syrup is the most frequently used drug, accounting for 18.8% of the total usage, indicating a high demand for nutritional supplements. Following closely are Paracetamol and Albendazole syrups, with 15.6% and 12.4% usage respectively, underscoring their common use in managing pain, fever, and parasitic infections. Metrogyl syrup also shows significant usage at 10.65%. In the realm of tablets, Ranitidine leads with 10.3%, highlighting its role in treating gastrointestinal issues. Other notable mentions include ORS powder at 9.5% and Levocetirizine syrup at 8.9%, which are vital in rehydration therapy and allergy relief respectively. On the lower end of the spectrum, Betamethasone injection and Tinidazole tablets are the least used, with 0.7% and 0.35% usage, respectively. This distribution emphasizes the predominance of syrups in pediatric or general medication use, while certain specific treatments like Betamethasone and Tinidazole are used sparingly.

3.7. Dosage Forms

- Syrup: The most common dosage form, including drugs like Paracetamol, Albendazole, Metrogyl, Dicyclomine, Lactulose, Levocetirizine, Onden, and Calcium. Tablet: This form includes drugs like Ranitidine, Cetrizine, B Complex, Probiotic, Zinc, Iron, Domepridone, Montelukast, and Neutraline-B. Powder: Only ORS is listed in this form. Drop: Only Nasal drop is listed in this form.

Table 5 Other drugs used with antibiotic

S.NO.	Drug	Frequency	Percentage
1.	Paracetamol	156	15.6
2.	Albendazole	124	12.4
3.	Metrogyl	106	10.65
4.	Dicyclomine	73	7.3
5.	Ranitidine	103	10.3
6.	Lactulose	51	5.1
7.	Multivitamin	188	18.8
8.	Levocetirizine	89	8.9
9.	Cetrizine	23	2.3
10.	B Complex	56	5.6
11.	ORS	95	9.5
12.	Onden	65	6.5
13.	Probiotic	32	3.2
14.	Zinc	65	6.5
15.	Iron	13	1.3
16.	Domepridone	26	2.6
17.	Calcium	75	7.5
18.	Montelukast	30	3.0
19.	Nasal drop	11	1.1
20.	Neutraline-B	8	0.8
21.	Theophilline	8	0.8
22.	Betamethasone	7	0.7
23.	Tinidazole	4	0.35

The table no.6 provides insight into the frequency and percentage of various drug combinations prescribed. The combination of Amoxicillin and Clavulanic acid (Am+Ca) is the most frequently prescribed, accounting for 28.37% of the total prescriptions. Following closely is the combination of Cefixime and Clavulanic acid (Cz+Ca), with 25.73%. Ciprofloxacin and Tinidazole (Ci+Ti) make up 18.04% of the prescriptions, while Norfloxacin and Ornidazole (No+Oz) account for 11.96%. Betamethasone and Gentamycin (Bm+Ge) are prescribed 8.71% of the time, and Montelukast and Levocitrizine (Ml+Lc) have a frequency of 7.50%. The combination of Norfloxacin and Tinidazole (No+Ti) is used in 5.47% of the cases, and Sulfonamide and Cotrimoxazole (Sm+Cz) are the least commonly prescribed, at 3.85%. The data suggests that combinations involving Clavulanic acid (Am+Ca and Cz+Ca) are particularly prevalent, together constituting over half of the total prescriptions at 54.1%.

Table 6 Combination of Drugs Used

S.No.	Combination of the Drugs	Frequency	Percentage
1.	Amoxicillin + Clavulanic acid (Am+Ca)	140	28.37%
2.	Cefixime + Clavulanic acid (Cz+Ca)	127	25.73%
3.	Ciprofloxacin + Tinidazole (Ci+Ti)	89	18.04%
4.	Norfloxacin + Ornidazole (No+Oz)	59	11.96%
5.	Betamethasone + Gentamycin (Bm+Ge)	43	8.71%
6.	Montelukast + Levocitrizine (Ml+Lc)	37	7.50%
7.	Norfloxacin + Tinidazole (No+Ti)	27	5.47%
8.	Sulfonamide + Cotrimoxazole (Sm+Cz)	19	3.85%

The data in Table No. 7 highlights a significant disparity between rational and irrational antibiotic prescriptions, with only 379 (37.9%) being deemed rational, where the use of antibiotics is justified. In contrast, a striking 621 (62.1%) prescriptions are classified as irrational, indicating antibiotics were prescribed unnecessarily.

Table 7 Total number of the rational and irrational prescription

S.No.	Category	Frequency	Percentage
1.	Rational Prescription (Antibiotic should use)	379	37.9%
2.	Irrational Prescription (Antibiotic should not use)	621	62.1%

4. Discussion

The recent study indicates that the baby girls are more affected with the cold, cough as compare to the male in this study the infants aging between 0 to 2 are more affected. The study reflected that the patients are more suffering with cough and cold due to the winter exposure or improper care or as the age increases, the immunity also developed. It was reported that during a one-year period, child in the United States suffered 1 billion colds [10]. This cough and cold mostly affected by virus and variety of antibiotics are used that are given to the patients. Irrationality was found more. Over prescriptions was common, particularly for a viral infections like common cold and cough. The choice of antibiotic often did not align with clinical guidelines, and the duration of treatment was frequently longer than recommended, that should be avoided the antibiotics use by giving the treatment firstly with antihistaminic, anti-leukotrienes and cough syrup etc. In most cases, no antibiotic therapy is needed for the treatment of acute respiratory disease in children, rehydration and precautions would be the key treatment [11].

This recent study indicated that the most common disease among the patients is "Cough," with 188 patients, which accounts for 18.8% of the total. The second most common disease is "Cold," with 145 patients, making up 14.5% of the total. "Loose Motion" is the third most common disease, affecting 123 patients (12.3%). "Abdominal Pain" has 72 patients, which is 0.72% of the total. Constipation" affects 43 patients (0.43%). "Vomiting" is seen in 29 patients (0.29%). "Shortness of Breath" affects 6 patients (0.6%). The least common disease is "Nausea," with only 10 patients,

accounting for 0.10% of the total. Symptoms like constipation, vomiting, having abdominal pain, are less common among these diseases. Shortness of breath is rarest of among all these disease we have analyzed in the recent work.

The data showed that respiratory and gastrointestinal issues are the most prevalent health concerns among pediatric patients. Cough and cold together account for a significant portion of the total cases (33.3%), indicating that upper respiratory tract infections are a major issue. The high incidence of loose motion (12.3%) and abdominal pain (7.2%) suggests that gastrointestinal disturbances are also common in this population. Cold wave has spread in many states of the country. When it gets cold, many health problems arise. The universal effect of this cold is being seen in the health of children. Due to the drop in temperature in winter, children have started experiencing stomach flu and breathing problems [12].

This recent study indicated that cefixime and amoxycillin are most prescribed drug, together representing 51% of the total prescription. When it was evaluated, the drugs in prescriptions revealed that Cefixime and Amoxycillin are the most common prescribed antibiotics which mean many patients have bacterial or viral infection treated by these drugs. Azithromycin and amoxyclave are the second most common prescribed antibiotics by doctors in paediatric patients. Norfloxacin, preclav, septron, ciprofloxacin are less prescribed antibiotic. Though, the health care person should start the prescribing the older antibiotics more initially like septron or ciprofloxacin but higher classes of Antibiotics started first like cefixime or amoxicilline. Most drugs are used in syrup form for easily intake because children have troubles to swallowing pills many of drugs are prescribed in different form according to suite patients need. The predominance of syrup formulations, especially among the most frequently used drugs, suggests a preference or necessity for liquid forms, which may be easier to administer, particularly in pediatric or geriatric populations. Liquid medicines are usually recommended for infants and younger children so the ability to mask unpleasant taste with sweeteners and flavours is crucial [13] but most of the time there is a lack of proper dosage of medicine to administer. Tablets and powders are also utilized, though less frequently, pointing to a varied approach in treatment methodologies.

There are different guidelines for the management of this condition. Centre of Disease Control and Prevention (CDC) emphasises prescribing antibiotics only in case of bacterial infection, while the viral type is self-limited. CDC suggests antibiotics according to the type of respiratory infection and tolerability in paediatrics. In acute sinusitis, amoxicillin or amoxicillin and clavulanate remain the first line of therapy. Amoxicillin and penicillin V are recommended for treating pharyngitis. In case of hypersensitivity, cephalexin, cefadroxil, clindamycin, clarithromycin, or azithromycin is recommended. In common cold and bronchiolitis, antibiotics should be avoided [14].

The high frequency of Multivitamin syrup usage indicates a significant demand for nutritional supplements, likely reflecting a focus on addressing deficiencies and promoting general health. Paracetamol and Albendazole syrups also show high usage, suggesting common issues related to pain, fever, and parasitic infections. The substantial use of Metrogyl syrup highlights its role in managing infections, while Ranitidine tablets' notable presence points to prevalent gastrointestinal disorders requiring treatment.

The usage of ORS powder (9.5%) underscores the importance of rehydration therapy, possibly due to gastrointestinal illnesses or dehydration. Levocetirizine syrup's 8.9% usage indicated its effectiveness in managing allergies. The lower frequencies of Betamethasone injection and Tinidazole tablets suggest these are reserved for specific, less common conditions or treatments.

The frequent use of the combination of Amoxicillin + Clavulanic acid (Am+Ca) suggests its effectiveness and broad-spectrum activity in treating bacterial infections. This combination is commonly prescribed to enhance the efficacy of amoxicillin by inhibiting beta-lactamase enzymes produced by resistant bacteria. Similarly, the combination of Cefixime + Clavulanic acid (Cz+Ca) at 25.73% indicated its significant role in combating infections, especially those caused by resistant strains. The combination with of beta lactamse antibiotics with clavulanic acid is used to treat certain infections caused by bacteria, including infections of the ears, lungs, sinus, skin, and urinary tract. Amoxicillin is in a class of medications called penicillin-like antibiotics. It works by stopping the growth of bacteria. Clavulanic acid is in a class of medications called beta-lactamase inhibitors. It works by preventing bacteria from destroying amoxicillin. Antibiotics will not work for colds, flu, or other viral infections. Using antibiotics when they are not needed increases your risk of getting an infection later that resists antibiotic treatment [15].

Ciprofloxacin + Tinidazole (Ci+Ti), being the third most used combination, highlights its importance in treating gastrointestinal infections, particularly those involving anaerobic bacteria and protozoa. The combination of Norfloxacin + Ornidazole (No+Oz) at 11.96% further underscores the necessity of dual-action drugs in managing complex infections.

The Betamethasone + Gentamycin (Bm+Ge) combination, accounting for 8.71% of usage, reflects its utility in providing anti-inflammatory and antibacterial effects, particularly in dermatological or severe systemic infections. Montelukast + Levocetirizine (Ml+Lc), used in 7.50% of cases, demonstrates its relevance in managing respiratory conditions such as asthma and allergic rhinitis, offering both anti-inflammatory and antihistamine benefits.

The lesser frequency of combinations like Norfloxacin + Tinidazole (No+Ti) and Sulfonamide + Cotrimoxazole (Sm+Cz) suggests these are reserved for more specific or less common infections, possibly due to resistance patterns or specific patient needs.

The data highlights a significant issue in antibiotic prescribing practices, with 62.1% of prescriptions classified as irrational, meaning antibiotics were used when they were not indicated. Although antibacterial resistance is a natural phenomenon, human factors exacerbate its emergence and spread. One major factor is the irrational use of antibiotics, which includes polypharmacy, self-medication with prescription-only medicines, use in non-bacterial infections, non-adherence to clinical guidelines, inadequate dosages, and inappropriate routes of administration. These practices expose bacteria to sub-optimal antibiotic levels, facilitating resistance. Globally, irrational antibiotic use is escalating, especially in low- and middle-income countries where policies are often not enforced. Even in developed countries, irrational use persists due to excessive prescriptions influenced by diagnostic uncertainty [16]. This high percentage underscores a concerning trend in overprescribing antibiotics, which can lead to several adverse outcomes, including the development of antibiotic-resistant bacteria, unnecessary side effects for patients, and increased healthcare costs.

Only 37.9% of the prescriptions were deemed rational, indicating that antibiotics were appropriately prescribed based on clinical indications. For some bacterial infections, antibiotics are life-saving medicines. Likewise, treatment with antibiotics is necessary for certain diseases, in order to ensure survival, welfare, productivity, and to reduce spread of disease. The goal of rational use initiatives is not always to reduce antibiotic use, but instead to ensure that the use is appropriate [17]. This suggests that there is a need for improved guidelines and stricter adherence to evidence-based prescribing practices to ensure antibiotics are used only when necessary.

5. Conclusion

The recent study highlights that baby girls are more susceptible to colds and coughs than boys, with infants aged 0 to 2 being particularly affected, likely due to improper care and winter exposure. The data showed that respiratory and gastrointestinal issues are the most prevalent health concerns among pediatric patients, with cough and cold accounting for 33.3% of the cases, indicating a significant issue with upper respiratory tract infections. Additionally, gastrointestinal disturbances such as loose motion and abdominal pain are also common. The study found a high frequency of antibiotic prescriptions, particularly cefixime and amoxicillin, which are often prescribed irrationally for viral infections like the common cold. This over prescription contradicts clinical guidelines that recommend antibiotics only for bacterial infections, raising concerns about the development of antibiotic-resistant bacteria, unnecessary side effects for patients, and increased healthcare costs. The study underscores the importance of adhering to guidelines, promoting rehydration and the use of antihistamines, anti-leukotrienes, and cough syrups for respiratory illnesses before considering antibiotics. It calls for improved prescribing practices to ensure antibiotics are used appropriately and only when necessary, emphasizing the need for evidence-based treatment to enhance patient safety and public health outcomes

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed

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