Antimicrobial stewardship using pharmacy data for the nurse-led school-based clinics in Counties Manukau District Health Board for management of group A streptococcal pharyngitis and skin infection

Jia-Yun Catherine Tsai, Philippa Anderson, Laura Broome, Tracy McKee, Diana Lennon

ABSTRACT

AIM: To evaluate antimicrobial usage in the school-based clinics against operating guidelines.

METHOD: Antimicrobial prescribing data (2014) from 10/18 participating pharmacies serving 14,153/23,588 primary school children of the programme were accessible. Prescriptions from 5/10 pharmacies were available for identifying type, amount, and indication of the medicine. One pharmacy serving a defined population (n=3,513) with single healthcare provider delivering the school programme was selected for detailed evaluation and identifying individuals receiving multiple treatments.

RESULTS: Data from 10 pharmacies (n=7,889 prescriptions) showed 91.2% of prescriptions were for group A streptococcal-positive throat swab, 8.8% for skin infections. More detail from 5/10 pharmacies showed only 2% of group A streptococcal pharyngitis treatments (107/4,672) were not first-line (56 cephalexin and 51 rifampin prescriptions). Fusidic acid (159/452, 35.18%) or cephalexin (169/452, 37.39%) were most commonly used for skin infection. Analysis in the defined population showed <4% (151/4,325) of assessed skin conditions received antimicrobials, and only 6 individuals received more than one course of oral antimicrobial over the year.

CONCLUSION: Antimicrobial administration demonstrates high compliance with the protocol. There was very limited use of second-line antimicrobials for recurrent pharyngitis. Most skin infections did not require antimicrobial treatment. Repeated antimicrobials for individuals were rare.

In New Zealand, infectious diseases continue to be unequally distributed with high hospitalisation rates seen for those living in the most disadvantaged areas. In Counties Manukau District Health Board (CMDHB), skin infection is a leading cause of medical admission in school-aged children, and the rate has been increasing. Similarly, rheumatic fever rates have also been increasing nationwide up to 2010, predominately in Māori and Pacific children 5 to 14 years of age. Nurse-led school-based clinics (Mana Kidz) aiming to improve access to primary care have been implemented in CMDHB since August 2012, with a focus on skin infections and rheumatic fever prevention, by treating group A streptococcal (GAS) pharyngitis. An evaluation has recently been published which shows early...
indications of intended effectiveness. The Mana Kidz programme, provided by a network of 9 primary care providers including Primary Health Organisations (PHOs) and Non-Government Organisations (NGOs), utilised a team comprising of a registered nurse and a whānau support worker (WSW), working in school-based clinics to deliver primary healthcare services, including daily assessments and treatments for throat and skin infections. This approach was first piloted in a sample school in South Auckland, and operational guidelines were developed (Manual of Operation and Standing Orders). Since the launch in 2012, the programme has been rolled out in 61 (predominately Decile 1) schools in CMDHB, reaching around 24,000 school children (5–12 years old) of whom approximately 40% were Māori and 50% Pacific Islanders. Treatment was provided under delegated standing orders, which authorise a registered nurse to supply and administer certain prescription medicines for indications specified in the instructions, without the authorising medical practitioner being present. This was approved by the Medicine Advisory Committee (now known as the Drugs and Therapeutic Committee) of CMDHB. Periodic audits were undertaken, and resistance patterns of common microbes were monitored through the DHB and national surveillance programmes.

Antimicrobial choices were based on published literature including the Heart Foundation of New Zealand's evidence-based, peer reviewed sore throat guideline, funding by PHARMAC, palatability and availability of elixirs and, in the case of amoxicillin, once a day medication regime to improve adherence. A brief summary of the treatment guideline is provided in Table 1.

The rising antibiotic resistance of bacteria is a major public health concern worldwide.

**Table 1: Summary of operational guidelines for group A streptococcal (GAS) sore throat and skin infection management.**

<table>
<thead>
<tr>
<th>GAS sore throat management</th>
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<tbody>
<tr>
<td><strong>Timing</strong></td>
<td>Ideally within 24 hours of the finding of a GAS positive throat swab result, after notifying the parent/caregiver, and obtaining agreement for antibiotic treatment</td>
<td></td>
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<tr>
<td><strong>Treatment options</strong></td>
<td>1. Not allergic to penicillin: oral amoxicillin once daily for 10 days</td>
<td>2. If allergic to penicillin: oral erythromycin twice daily for 10 days</td>
</tr>
<tr>
<td><strong>Other consideration</strong></td>
<td>1. Third consecutive throat swab culture positive for GAS within 3 months: oral cephalaxin twice daily for 10 days*</td>
<td>2. A fourth consecutive throat swab culture positive for GAS: oral rifampin once daily for the last 4 days of 10-day course of amoxicillin or other options</td>
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<tr>
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<td>3. Student already on cephalaxin for a skin infection, oral cephalaxin will be extended to a 10-day course from date of throat swab finding</td>
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<table>
<thead>
<tr>
<th>Skin infection management</th>
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<tbody>
<tr>
<td><strong>Timing</strong></td>
<td>As soon as possible after initial assessment</td>
<td></td>
</tr>
<tr>
<td><strong>Treatment options if antimicrobials are required</strong></td>
<td>1. Localised lesion (&lt;5% of body surface area): topical fusidic acid 3 times per day until healed or up to 10 days maximum</td>
<td>2. Larger lesions or multiple lesions (&gt;5% of body surface area): Oral cephalaxin twice daily for 5 days, for student not allergic to penicillins or cephalosporins, and unable to swallow capsules</td>
</tr>
<tr>
<td></td>
<td>3. Oral flucloxacillin three times a day for 5 days, for student not allergic to penicillins or cephalosporins, and able to swallow capsules</td>
<td>4. Oral erythromycin twice a day for 7 days, for student allergic to penicillin and/or cephalosporins</td>
</tr>
<tr>
<td><strong>Other considerations</strong></td>
<td>1. Non-bacterial infection such as scabies: permethrin lotion</td>
<td>2. Persisting infection: consider skin swab. If positive for methicillin resistant Staphylococcus aureus (MRSA): oral co-trimoxazole twice daily for 7 days</td>
</tr>
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* Management for recurrent GAS pharyngitis has been modified from early 2015: intramuscular (IM) penicillin, direct observed therapy (DOT) of amoxicillin or oral cephalaxin are the new algorithm for treating the 3rd GAS-positive swab. Rifampin combined with amoxicillin or alternative antimicrobial is only used for persistent GAS pharyngitis confirmed by post-treatment swab.
and in New Zealand. Increased community consumption of antimicrobials has been shown to be one of the factors driving increasing resistance.\textsuperscript{11-13} Concern has been raised that a programme such as this may have the unintended consequence of inappropriate antimicrobial use, and thus impact on antibiotic resistance patterns. At the time the programme was established, there was a dispensing charge for families to collect a prescription, and one of the priorities of the programme was that antimicrobials would be easily available if indicated, and free of charge, which has been achieved by the use of the Practitioner Supply Order (PSO). However, one of the recognised disadvantages of this approach is that the dispensing information is no longer available through the nationally-collected pharmaceutical database, which can make monitoring the patterns and trends in antimicrobial dispensing challenging.

In 2014, 23,588 school-aged (5–12 years old) students were enrolled at the 61 participating schools and consented into the Mana Kidz programme. There were 12,127 GAS pharyngitis and 13,348 skin infections treated in the programme in 2014 (some students were treated more than once), accounting for 47.6% and 52.4% respectively of all treatments documented by the Mana Kidz programme. However, there is no information on these treatments, such as the treatment type and antimicrobial usage. The aim of this audit is to analyse and summarise the antimicrobial dispensing pattern of the Mana Kidz programme in 2014 against agreed protocols.

Methods

Due to the lack of a nationally-collated database of prescribing history, pharmacies participating in the programme were approached for data. As record storage methods and disclosure policies are different between each pharmacy, only 10 out of the 18 participating pharmacies (serving approximately 14,100 students) were able to provide prescribing data. Five pharmacies serving a population of about 9,000 were evenly located in the four main geographic regions involved in the Mana Kidz programme (Manurewa, Mangere, Otara and Papakura) were included, as their prescribing data contained complete information for the purpose of this audit. The following information was extracted from each record (ie, from PSOs, standing order forms, or prescription detail reports of the pharmacy, collectively referred to as a ‘prescription’ hereafter): date, name of medicine, amount, and indication. One subset was chosen as the sample region for further detailed analysis due to the following reasons:

1. All of the nurses and whānau support workers (WSWs) conducting the programme in this subset were from the same healthcare provider—with its own operating pharmacy—that serves 3,513 children enrolled in 9 primary schools.
2. This provider has delivered the programme since February 2013, and has consistent practices and well-established recording systems to facilitate the collection of reliable data.
3. Standing order forms for the calendar year 2014 were appropriately filed and stored at this pharmacy, which provide information to an individual level. The NHI (National Health Index) number (or date of birth, if the NHI number was not available) of the patient on each prescription was captured, in order to identify repeating infections of the same individual, or multiple treatments administered for the same infection event.

The scheme of data acquisition and utilisation is summarised in Figure 1.

Results

Overview of antimicrobial dispensing pattern in 2014

23,588 students were enrolled at the 61 participating schools and consented into the Mana Kidz programme in 2014. Data collected from the 10 pharmacies covering 14,153 students (representing ~60% of the whole population involved in the Mana Kidz programme) showed that a total of 7,889 prescriptions were filled in 2014. Amoxicillin (n=7,122, 90.3%) was the majority among the 7,786 antimicrobial prescriptions. Other antimicrobial prescriptions comprising this dispensing volume were: cephalexin (n=365, 4.6%), topical fusidic acid (n=159,
2.0%), erythromycin (n=69, 1.4%), rifampin (n=51, 1.1%), flucloxacillin (n=14, 0.2%) and co-trimoxazole (n=3, <0.1%). There were a small number of non-antibiotic medications, such as permethrin for treating scabies (n=103). Prescribing data from the five pharmacies selected for this audit showed that a total of 5,124 prescriptions were filled in 2014 for this population. Among them, 4,566 prescriptions (89.1%) were given for GAS-positive throat swab findings (throat swabs are only performed with symptoms), and 2.1% (n=106) were prescribed for recurrent GAS pharyngitis. A relatively small portion (n=452, 8.8%) of these prescriptions were indicated for skin infections, including impetigo (324/452, 71.7%), cellulitis (6/452, 1.3%), infected eczema (16/452, 3.5%), scabies (102/452, 22.6%) and confirmed methicillin-resistant S. aureus (MRSA) (4/452, 0.9%) infections unresponsive to first line treatments.

As shown in Table 2, of the 452 prescriptions for skin infections, 22.2% were non-antibiotic ointment for treating scabies (5% permethrin cream). As for antimicrobial prescriptions, cephalaxin (n=159, 35.3%) and topical fusidic acid (n=169, 37.4%) were the most common antimicrobials prescribed for various skin infections in 2014, followed by flucloxacillin (2.9%), erythromycin (1.8%), and co-trimoxazole (less than 0.7%).

The most common antimicrobial choice for treating symptomatic GAS-positive throat infection was amoxicillin (96.7%). Cephalexin and rifampin were used to treat recurrent GAS-positive throat swab findings within 3 months, and accounted for 1.2% (n=56) and 1.1% (n=51) of all the prescriptions, respectively. Less than 1% of the throat infection cases (n=46, 0.98%) were treated with erythromycin.

With detailed information enabling analysis at an individual level, a sample subset was used for identifying repeating infections in the same individual, and multiple treatments for a single infection.

Population-based analysis in the sample subset
In 2014, total of 3,513 children were enrolled and consented into the programme in this sample subset of 9 schools. Data from this subset show a total of 1,921 GAS-positive throat swabs were found in 2014, and 1,384 cases received treatment within the programme, while the rest obtained medical care from their GPs. It is important to note that in July 2014 a supply issue (due to a recall of the funded brand) made amoxicillin...
Table 2: Number and percentage of each medication dispensed for skin or throat infection in 2014. (Data from n=5 pharmacies).

<table>
<thead>
<tr>
<th>Skin infection treatments</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Cephalexin</td>
<td>37.39%</td>
</tr>
<tr>
<td>Fusidic acid</td>
<td>35.25%</td>
</tr>
<tr>
<td>Flucloxacillin</td>
<td>2.88%</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>1.77%</td>
</tr>
<tr>
<td>Co-trimoxazole</td>
<td>0.67%</td>
</tr>
<tr>
<td>Non-antibiotics</td>
<td>22.17%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>452</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Throat infection treatments</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>96.73%</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>0.98%</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>1.21%</td>
</tr>
<tr>
<td>Rifampin</td>
<td>1.09%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,672</strong></td>
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</table>

temporarily unavailable to the programme. While the programme has protocols to ensure such students source treatment from alternative suppliers, the records cannot be captured for this audit. A total of 4,325 cases of skin conditions were assessed by Mana Kidz staff; of the 3,860 cases that were deemed required treatment, 3,677 were treated with cleaning and covering only, another 32 cases were treated with non-antibiotic ointment such as permethrin, leaving 4% (151/3,860) of skin conditions treated with an antimicrobial.

Numbers of prescriptions by medication and indication are summarised for this subset in Figure 2. In line with the overall antimicrobial dispensing pattern of this audit (shown in Table 2), amoxicillin is the most commonly used medicine for treating GAS pharyngitis (1,323/1,384, 96%), followed by cephalexin (30/1,384, 2%). A total of 61 children received antimicrobials other than amoxicillin for a GAS-positive throat swab culture (4.41% of the 1,384 prescriptions) through the Mana Kidz programme. Of these children, 16 were treated with erythromycin (1.06%), and the other 45 prescriptions (3.25%) were cephalexin or rifampicin, reflecting the recurrent throat infection rate in this population. One child was treated three times with erythromycin, with intervals of 16 and 3 weeks between each prescription.

As for skin infection, topical antimicrobial fusidic acid is the most commonly used medication (85/183, 46.4%), followed by cephalexin (52/183, 27.9%) and non-antibiotic permethrin lotion (32/183, 17.5%). Among the less commonly used medications, erythromycin accounted for 4.4% (8/183) of all skin infection prescriptions. Co-trimoxazole and flucloxacillin prescriptions were the least common among the 6 medications (both 3/183, 1.6%). Impetigo was the most common skin condition that required medication (122 out of the 183 cases in total), followed by scabies (34 cases), and infected eczema (16 cases). There were 6 cellulitis cases and 4 positive MRSA findings (skin swabs for culture are only performed when a skin infection fails to respond to treatment) treated with antimicrobials. In all, only five children received two courses of oral antimicrobials, and one child received three courses of oral antimicrobials for a skin infection in this sample subset in 2014.

Of all the impetigo cases, 58.7% were treated with topical fusidic acid, 34.7% with cephalexin, and 3.3% with either erythromycin or flucloxacillin. One impetigo case was treated with co-trimoxazole. All cellulitis cases were treated with cephalexin, whereas infected eczema was mostly treated with topical fusidic acid (75%). Although the majority of scabies cases were treated with non-antibiotic ointments, two out of the 32 scabies cases received topical fusidic acid concurrently. The rare occasions of positive MRSA infections (skin swabs for culture are not routine care) were treated with either erythromycin or co-trimoxazole (2 cases each).

Discussion

The Mana Kidz programme has been highly accepted in the community since its launch in 2012. The high consent rate (94%) and the timely action taken by registered nurses (throat swab results were usually obtained within 48 hours, and medications given within 24 hours upon confirmation of the infection) ensure throat and skin infection were treated effectively and per protocol.
Figure 2: Distribution of prescriptions by medication (left) and indication (right) prescribed for the sample subset in 2014 for a local population of n=3,513.

Skin infection

- Fusidic acid 46%
- Cephalexin 28%
- Erythromycin 4%
- Permethrin 18%
- Fluclaxocillin 2%
- Co-trimoxazole 2%

Throat infection

- Amoxicillin 96%
- Cephalexin 2%
- Erythromycin 1%
- Rifampicin 1%

The programme provides children in Counties Manukau access to primary health care for common conditions, and there is evidence to suggest that it is lowering disease burden in this population. In 2014, a high number of treatments were provided through the programme (12,127 GAS pharyngitis cases and 13,348 skin assessments) for this population of approximately 24,000 children, but no information was given on the medication used. Due to the national and global concern on continuous rise of antimicrobial resistance, this audit utilised pharmacy data to evaluate antimicrobial dispensing by the programme. Considering the evenly-distributed geographical location and provider association of the pharmacies involved in this audit, the pattern of antimicrobial usage demonstrated by this analysis is likely to be representative of the whole programme. Furthermore, using a detailed dataset from a defined population served by one pharmacy, this audit was able to provide information about antimicrobial usage on an individual level.

Antimicrobial dispensing by the Mana Kidz programme displays high compliance with the operating guidelines in terms of treatment options and frequencies, reflecting condition-appropriate antimicrobial prescribing sanctioned at the start of the programme. Second-line antimicrobials were used sparingly for repeated GAS pharyngitis, and most skin conditions did not receive either topical or oral antimicrobials, but instead were treated with cleaning and covering of the lesions.

This audit found an important protocol deviation that is now being rectified. According to the Manual of Operations supporting the nurse-led clinics and the use of antimicrobials by delegated authority, the agreed approach for skin infection management was that topical fusidic acid alone should be used for infections with localised lesions, while oral cephalexin is reserved for more extensive conditions. This audit found simultaneous use of the two antimicrobials in 12 cases, although this might be explained by the severity of the infection was on borderline between these two treatment suggestions.

In a previous review of sore throat management in New Zealand general practice, data collected from the National Primary Medical Care Survey showed that 61% of sore throat patients, which consisted mostly of Māori and Pacific children aged 5–14 years, were prescribed
an antimicrobial, while much less throat swabbing (6.6%) was done in this cohort. With the higher prevalence of viral causes of sore throat, administration of antimicrobials without confirmation of the infection agent could be an underlying cause of antimicrobial overuse. It is acknowledged that an up-to-date general practice audit would be informative following the recent increased messaging and guideline availability on pharyngitis management in populations at high and low risk. The New Zealand Heart Foundation’s GAS sore throat management guideline emphasised that throat swabbing remains the gold standard for diagnosing GAS pharyngitis, and is especially recommended for symptomatic school-aged subjects. In the protocol-driven Mana Kidz Programme, school children were only treated with confirmed GAS-positive throat swab, suggesting the practice of this programme can deliver appropriate antimicrobial treatments at the primary healthcare level. It is acknowledged some of these may represent GAS carriage in the context of a viral sore throat. However, this still results in far less antimicrobial being used than if a sore throat was the only criterion for treatment.

This audit showed that the majority of antimicrobials prescribed were the first-line treatment, amoxicillin. In the period for this audit (2014), cephalalexin (as alternative when available by Standing Orders) was used when a third consecutive pharyngeal GAS isolate was found within 3 months; on a case-by-case basis, rifampin combined with amoxicillin (prescribed outside the programme) was used when a fourth consecutive throat swab culture positive for GAS was found. Management for recurrent GAS pharyngitis has been modified from early 2015 to further reduce rifampin use. The new algorithm for treating the third GAS-positive swab is intramuscular (IM) penicillin, direct observed therapy (DOT) of amoxicillin or oral cephalalexin. Rifampin combined with amoxicillin or alternative antimicrobial is only used for persistent GAS pharyngitis confirmed by post-treatment swab.

Regarding skin infection, in 2014 the total number of skin conditions assessed at the 61 Mana Kidz schools was 20,586, and the total number of skin infection recorded as ‘treated’ by the programme was reported to be 13,348. One aim of this audit project is to differentiate treatment by cleaning and covering, as well as non-antibiotic treatment, from antimicrobial treatment. Data from the sample subset provide detailed information to the individual level for this objective, which suggest the majority of the skin conditions (more than 95%) received conservative treatments without the use of antimicrobials. The significant difference between the number of skin conditions assessed and the number of cases requiring medical treatment also indicates that the self-report rate of skin conditions by school children was high. During this audit it was found that a large number of these self-reported cases were superficial lesions such as scratches, insect bites or old scabs, which could be managed with conservative treatment (cleaning and covering) or required no treatment. Furthermore, only a small number of students received more than one antimicrobial from the programme for their skin infections within this 1-year period. There is ongoing research looking at the impact of the programme on skin infection hospitalisations, and the results will provide a useful outcome measurement for the programme.

To date, globally, no penicillin-resistant GAS isolate has been observed, and erythromycin resistance is low in New Zealand. However, it has been reported that the high usage of topical fusidic acid is associated with a clonal expansion of fusidic acid-resistant Staphylococcus aureus strain in New Zealand. The use of topical fusidic acid in this programme is worthy of reflection, as most fusidic acid prescriptions were filled for impetigo as a first-line treatment. Impetigo can be caused by Staphylococcus aureus, Streptococcus pyogenes, or the combination of the two. The relative contribution of the two bacteria in impetigo has not been studied in New Zealand. As swabs from skin lesions for culture are rare in this programme, we have no data on treatment failure and the need to progress to an oral antimicrobial due to known antimicrobial resistance. The latest Cochrane review finds the evidence for efficacy of alternative treatment options for impetigo, such as disinfecting solutions, is still insufficient. Topical fusidic acid is currently
the only fully-funded topical antimicrobial indicated for treating minor impetigo in New Zealand, and is better accepted in the community while causing less and milder side effects than oral antimicrobials. Therefore, the benefits of using fusidic acid in an area with high disease prevalence need to be weighed against the risk of increasing antimicrobial resistance.

This audit is conducted as an on-going part of the programme among other review procedures, and a further audit of antimicrobial usage for 2015 is planned (funding permitting). Data from the pharmacies compensate the lack of nationally-collated database of prescribing history. The major limitation of this audit was the pharmacy data were not intended for this purpose in the first place, therefore due to the variations between each pharmacy's data documentation and storage, this audit could only provide a summary with reasonable estimations. The lack of an appropriate national database and established benchmarks for comparison is a common challenge for antimicrobial stewardship. The dispensing practices of the programme also need to be reviewed, in light of the new funding for free prescriptions for under 13-year-olds, to determine if there is a way that individual data can be entered into the national pharmaceutical database. Another limitation of using pharmacy data is that the prescribing records may not accurately represent actual antimicrobial consumption, as the patients’ adherence to medication regimens varies. Furthermore, it should be kept in mind that an unknown number of students may have been treated outside the programme, as it was noted in the pilot evaluation that about 6% of students had their skin conditions treated by their GP either before or after self-reporting to the WSW and more than 50% of the parents participating in a survey conducted in May 2014 indicated they chose GP as the primary care for their children’s illness.

Conclusion

Antimicrobial dispensing data sampled from the 5 participating pharmacies provide information on the pattern and trend of antimicrobial use for the programme. Antimicrobial administration for throat and skin infections demonstrates high compliance with the protocol. Further investigation in the sample dataset shows that the prescribing pattern is conservative, and repeating exposure per person is uncommon, suggesting antimicrobials are used judiciously in this programme.

It has been reported that the burden of infectious disease in the CMDHB population translates into high community antimicrobial use. This antimicrobial stewardship audit provides affirmation that the implementation of the Mana Kidz programme does not lead to excessive prescribing of second-line antimicrobials in CMDHB. In fact, if the school-based clinics are effective in lowering infectious disease prevalence by improving primary healthcare accessibility, and there is high compliance to the protocol, then it can be concluded that the programme supports judicious antimicrobial use in this population.
Competing interests:
Nil

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