A cost analysis and availability scenario of drugs and oral care products prescribed for common oral conditions with reference to the current Indian market prices, Jan Aushadhi, and the state medical commissions

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Abstract
Context: The prevalence of oral mucosal lesions across various countries varies from 4.9% to 64.7%. The cost barrier is an important factor that prevents people in low-middle income countries from seeking professional help for dental problems. Aims: The present study aims to analyze the costs of medicines and oral care products prescribed for common oral lesions and to find the most expensive and the most economic brands. Methods and Material: The list of medicines and oral care products prescribed for the management of four oral conditions namely, recurrent aphthous stomatitis, oral candidiasis, oral herpetic, and gingivitis were taken and their median retail prices, cost variation percentages were calculated from the current Indian market brands. The median retail prices were compared with their corresponding Jan Aushadhi prices. Also, the availability of the drugs and oral care products were evaluated across the state drug procurement lists of Tamil Nadu, Rajasthan, Uttar Pradesh, Telangana, and Bihar. Results: Wide cost variations were seen in most of the drugs and oral care products. The Jan Aushadhi prices of included drugs were very economical compared to the median market prices. However, the availability of the drugs was less in the Jan Aushadhi list and also in the state medical commission lists. Conclusions: The availability of such commonly used drugs in oral conditions has to be ensured in state and central governments. Price regulations of drugs routinely prescribed by dentists will help reduce the overall treatment costs for dental care.

Keywords: Cost analysis, Jan Aushadhi, oral conditions, state medical commissions

Introduction
Oral mucosal lesions refer to any abnormality or alteration in the color, surface, texture, and/or a loss of integrity of the oral mucosa. The prevalence of oral mucosal lesions across various countries varies from 4.9% to 64.7%. The most common oral lesions are recurrent aphthous stomatitis (RAS), oral candidiasis, oral herpetic, and oral manifestations of systemic diseases. In rural and urban areas due to limited access to dentists, primary care providers and family physicians often have to deal with patients presenting with such lesions. Primary care practitioners and family physicians usually plan for short term pain relief, antibiotics followed by referral to a dentist. Studies show that primary care physicians see patients with dental complaints from anywhere ranging from “everyday” to “10 per month”, highlighting the fact that both dentists and primary care physicians will have to deal with patients presenting with such lesions. The availability of such commonly used drugs in oral conditions has to be ensured in state and central departments by the policy makers. Price regulations of drugs routinely prescribed by dentists will help reduce the overall treatment costs for dental care.

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providers have to work at an extended capacity to meet the oral care needs of the patients.\(^{(3)}\)

In lower-middle-income countries like India where there is a lack of robust insurance coverage, dental expenses directly impact the household finances. In a study done in 41 lower-middle-income countries, up to 35% of households reported having some dental health expenditure in the past 4 weeks, and out of them, 7% had catastrophic dental health expenses.\(^{(6)}\) Apart from the cost of dental treatments, the unregulated cost of different brands of medicines plays a major role in determining affordability. Dentists and primary care physicians need to be aware of the cost factor and the quality of medicines that tend to change from time to time.

Pradhan Manthri Jan Aushadhi Pariyojana is a campaign initiated in 2008 to provide high-quality, affordable generic medicines to the public. More than 7700 Jan Aushadhi outlets are catering to people’s needs across the nation.\(^{(3)}\) The present study aims to analyze the costs of medicines and oral care products prescribed for common oral lesions and to find the most expensive and the most economic brands. The median drug prices will be compared with the Jan Aushadhi price list to find the most economic source of drugs.

**Objectives**

1. To find the cost variations in the various brands of medicines and oral care products prescribed for recurrent aphthous stomatitis, oral candidiasis, oral herpes, and gingivitis available in the Indian market.
2. To compare the median rates of the current market brands of the medicines and oral care products prescribed for recurrent aphthous stomatitis, oral candidiasis, oral herpes, and gingivitis with the corresponding Jan Aushadhi prices.
3. To compare the availability of the medicines and oral care products prescribed for recurrent aphthous stomatitis, oral candidiasis, oral herpes, and gingivitis among the state drug procurement lists of Tamil Nadu, Telangana, Uttar Pradesh, Rajasthan, and Bihar.

**Material and Methods**

The list of medicines and oral care products prescribed for the management of four oral conditions namely: RAS, oral candidiasis, oral herpes, and gingivitis were taken from Burket’s textbook of oral medicine, which is a widely used reference for oral medicine and therapeutics among the dental fraternity. Various brands and the costs of these medicines/oral care products were obtained from the current index for medical specialties 43rd issue published in 2021. The price of each drug was measured in the cost/defined daily dose (DDD) unit. The cost/DDD for drugs was calculated by multiplying the unit cost of particular strength and the number of units needed to maintain the DDD. The cost of topical ointments and oral gels were taken directly from the Current Index of Medical Specialties (CIMS) and Jan Aushadhi lists. Though packages of varying weights were available, the price for a standard weight of 10 gm tube was considered. The percentage of cost variation and the cost ratio were calculated for each drug. The median price of all drugs was estimated and a list was prepared. The price of the medicines/products included in Jan Aushadhi was taken and compared with the median prices.

Cost variation = Maximum cost-minimum cost/minimum cost × 100

Cost ratio = Highest costing brand/Lowest costing brand

To check for availability in the state commissions, five states were included. Two states from the northern part (Rajasthan, Uttar Pradesh), two states from the southern part (Tamil Nadu, Telangana), and one state were selected from the central part of India (Bihar). The current drug procurement lists from the medical service commissions of all the included states were taken from their respective official websites and the availability of the drugs and oral care products was evaluated.

**Results**

A total of 13 drugs and three oral care products were included for the analysis. The total number of brands for individual drugs varied from two brands for 2% miconazole ointment to 105 brands for chlorhexidine mouthwash. A wide cost variation was observed among different brands of drugs. The highest percentage cost variation was 1107.5% for gum paint followed by 758.9% for 1% clotrimazole ointment and 596% for 2% lidocaine ointment. The least-cost variation was 8.7% for 5% amlexanox ointment. On the calculation of the cost ratio between the most and least expensive brands of drugs, the highest cost ratio was in gum paint (12.1) followed by 1% clotrimazole ointment (8.6) and ointment benzocaine (6.0). The least-cost ratio was 1.5 for ointment miconazole followed by 2.7 for tablet acyclovir (400 mg) and tablet famciclovir (500 mg). The highest price range between the least and most expensive drugs was in gum paint (Rs. 241.5-20.0) followed by ointment ketoconazole (Rs. 186-42.5) and ointment clotrimazole (Rs. 140-16.3). The least price range was Rs. 86-79 for ointment amlexanox followed by Rs. 27-10 for tablet acyclovir (400 mg). The various drugs and oral products and their price variations are listed in Table 1.

Out of the 13 drugs and three oral care products included in this analysis, a total of six drugs and one oral care product were available in the Jan Aushadhi drug list. When the median market prices and the Jan Aushadhi prices of these drugs and oral care products were compared, a high-cost variation percentage was observed. The highest cost variation was 767.9% for tablet ketoconazole (200 mg) followed by 500% for tablet acyclovir (400 mg). The lowest cost variation percentage was 81.3% for ointment lidocaine. The highest cost ratio was 8.7 for tablet ketoconazole (200 mg) and the lowest cost ratio was 1.8 for ointment lidocaine [Table 2, Figures 1 and 2].
Among the state drug procurement lists, the highest availability was seen in Tamil Nadu with five drugs (tablet acyclovir, topical lidocaine, 1% clotrimazole ointment, tablet fluconazole, and tablet ketoconazole) followed by Uttar Pradesh with three drugs (tablet acyclovir, topical lidocaine, and tablet fluconazole). The least availability was seen in Telangana (topical lidocaine, 1% clotrimazole ointment), Rajasthan (tablet acyclovir, 1% clotrimazole ointment), and Bihar (topical lidocaine and tablet fluconazole).

**Discussion**

Oral care is an indispensable part of health care service that needs attention time and again. Key barriers in receiving timely treatment for oral conditions are lack of awareness and out-of-pocket expenditure. A total of 298 billion US dollars were spent to cover the direct costs of treating common oral diseases every year globally. This represents 4.6% of the total health expenditure in a global scenario. In the present study, common oral conditions like RAS, oral herpes, oral candidiasis, and gingivitis were included. Apart from analyzing the prices in the Jan Aushadhi list, the availability of selected drugs and products were checked across various state commissions. Only six drugs and one oral care product were available in Jan Aushadhi and their availability was even lesser in the states. This brings to light the fact that despite the availability of dental services in state and central government hospitals, the lack of availability of drugs and oral care products compels the patients to buy them at retail prices from private sectors.

Recurrent aphthous stomatitis is a common oral disease with a high prevalence of 25% in the general population. Various therapeutic modalities like topical anesthetics, anti-inflammatory agents, and topical corticosteroids are used widely. Amlexanox is the only clinically proven drug approved by the US Food and Drug Administration for the management of RAS. The other commonly prescribed agents are topical benzocaine and 1% topical triamcinolone acetonide. However, amlexanox, benzocaine, and triamcinolone acetonide were not available in Jan Aushadhi list or the drug procurement lists of all five states. The cost variation percentage among various brands in the Indian market was as high as 500% for ointment benzocaine and 113.2% for 1% topical triamcinolone acetonide.

### Table 1: Cost analysis of drugs prescribed for common dental conditions

| Item          | Strength | ATC Code | Formulation | No of brands | Highest price (INR) | Lowest price (INR) | Cost ratio | % cost variation |
|---------------|----------|----------|-------------|--------------|---------------------|--------------------|------------|-----------------|
| Amlexanox     | 5%       | A01AD07  | Ointment    | 3            | 86                  | 79                 | 1.1        | 8.7             |
| Benzocaine    | 20%      | A01AD    | Ointment    | 3            | 120                 | 20                 | 6          | 500             |
| Triaminolone  | 0.1%     | A01AC01  | Ointment    | 8            | 81                  | 38                 | 2.1        | 113.2           |
| Acyclovir     | 400 mg   | J05AB01  | Tablet      | 7            | 27                  | 10                 | 2.7        | 170             |
| Famiclovir    | 500 mg   | J05AB09  | Tablet      | 3            | 87.5                | 41                 | 2.1        | 113.4           |
| Acyclovir     | 5%       | J05AB01  | Ointment    | 4            | 74.75               | 45                 | 1.7        | 66.1            |
| Lidocaine     | 2%       | A01AC    | Ointment    | 6            | 34.80               | 5                  | 7          | 596             |
| Benzydamine   | 0.15%    | A01AD02  | Ointment    | 10           | 135.8               | 83                 | 1.7        | 63.6            |
| Clotrimazole  | 1%       | A01AB18  | Ointment    | 9            | 140                 | 16.3               | 8.6        | 758.9           |
| Ketoconazole  | 2%       | J02AB02  | Ointment    | 9            | 186                 | 42.5               | 4.4        | 337.6           |
| Fluconazole   | 150 mg   | J02AC01  | Tablet      | 34           | 26.9                | 7.9                | 3.4        | 240.5           |
| Ketoconazole  | 200 mg   | J02AB02  | Tablet      | 5            | 40.6                | 15                 | 2.7        | 170.7           |
| Miconazole    | 2%       | A01AB09  | Ointment    | 2            | 69                  | 45                 | 1.5        | 53.3            |
| Tooth paste   | -        | A01AA    | Paste       | 97           | 165                 | 29                 | 5.7        | 469             |
| Gum paint     | -        | A01AB    | Ointment    | 35           | 241.5               | 20                 | 12.1       | 1107.5          |
| Chlorhexidine | 0.2%     | A01AB03  | Mouth wash  | 105          | 107                 | 25                 | 4.3        | 328             |
Herpes simplex type 1 virus infection is a self-limiting condition that causes oral and perioral blisters. Studies have shown an annual prevalence of 17% with 20–40% of the general population experiencing such oral blisters at some point in their life. Topical and systemic formulations of acyclovir, famciclovir, topical benzydamine, and lidocaine are the commonly prescribed agents. Only tablet acyclovir 400 mg and topical lidocaine were available in the Jan Aushadhi price list. The cost variation between market retail prices and Jan Aushadhi prices for tablet acyclovir 400 mg was as high as 500% and for topical lidocaine was 81.3%. Tablet acyclovir 400 mg was available in three states, namely, Tamil Nadu, Rajasthan, and Uttar Pradesh. Topical lidocaine was available in four states namely Tamil Nadu, Telangana, Bihar, and Uttar Pradesh. Topical benzydamine, tablet famciclovir, and topical acyclovir were not available in the Jan Aushadhi list or any of the five states. It is to be noted that topical acyclovir is a more widely preferred formulation for managing Herpes labialis due to its ability to soothe pain, itching, and burning. The inclusion of such commonly prescribed drugs has to be initiated to cut down the costs of receiving dental treatment.

Oral candidiasis is a common opportunistic infection with a prevalence of 40–60% in healthy individuals and 62–93% in immunocompromised patients. The treatment for oral candidiasis includes clotrimazole, fluconazole, ketoconazole, and miconazole in various formulations like troche, creams, oral suspensions, powders, and tablets. A total of 1% clotrimazole ointment, 2% ketoconazole ointment, tablet fluconazole, and tablet ketoconazole were included in the Jan Aushadhi price list. The percentage cost variation among the anti-fungal drugs was the highest for 1% clotrimazole ointment with 758.9%, followed by 2% ketoconazole ointment with 357.6%. When the median retail prices and the Jan Aushadhi rates were compared, the highest cost variation percentage was found in tablet ketoconazole (767.9%) followed by 1% clotrimazole ointment (335.7%).

Medicated toothpaste is often prescribed by dentists for orthodontic patients and patients with rampant caries. These products are used for caries prophylaxis and contain potassium nitrate, sodium monofluorophosphate, calcium phosphate, triclosan, etc. There were 97 brands of medicated toothpaste with a high-cost variation of 469%. Medicated toothpaste was not included in Jan Aushadhi or any of the state drug procurement lists. Since the American Dental Association recommends the use of fluoride-containing toothpaste, mouth rinses, and gels to prevent dental caries among all age groups, these products are routinely prescribed by dentists. A patient with rampant caries undergoing multiple caries management may need such oral care products for a few weeks till the treatment is completed or even longer for maintenance of good oral status. In such cases, when there is no effective price regulation, it directly causes an excessive financial burden to patients, forcing them to miss further treatment.

Gingivitis and periodontitis are common oral conditions that require immediate attention. Various natural products containing active phytochemicals with antiseptic, astringent, anodyne, and styptic properties have been proved to be effective under such inflammatory conditions. Topical agents like gum paints are recommended by dentists for post-procedural management of deep scaling, gingival curettage, root planning, and flap surgeries. However, gum paint had the highest cost variation among all the drugs and products included in this study with a variation of 1107.5%. Gum paint was neither included in the Jan Aushadhi price list nor any of the state drug procurement lists.

Plaque inhibiting agents like chlorhexidine help in the long-term maintenance of oral hygiene. Previous studies have stated the superior role of chlorhexidine in inhibiting the growth of various gram-positive and gram-negative, aerobic, and anaerobic bacteria in the oral cavity. Recent studies reveal the effectiveness of chlorhexidine in reducing Severe acute respiratory syndrome (SARS) viral load in the oral cavity thus speculating its efficacy in combating the spread of covid-19 in dental offices. It has been recommended as a part of pre-procedure prophylaxis for several dental treatments. In the present study, we found a total of 105 different brands of chlorhexidine mouthwash with a high-cost variation of 328%. The cost variation between median retail price and the Jan Aushadhi rate of chlorhexidine mouth wash was as high as 126.2%. When we look at the availability of chlorhexidine in state drug procurement lists, none of the states have included chlorhexidine, which is alarming. Considering the inevitable role of chlorhexidine in providing quality oral care, it has to be included and its price has to be regulated across state and central drug procurement commissions.

Oral health can be improved in rural areas by building the capacity of non-dental care providers like family physicians who are more accessible than general dentists. The dental healthcare

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**Table 2: Comparison of rates between median retail prices and the Jan aushadhi prices for selected drugs**

| Item          | Strength | Formulation | Median retail price | IQR | Cost in Jan aushadhi | Cost ratio | % Cost variation |
|---------------|----------|-------------|---------------------|-----|----------------------|------------|-----------------|
| Clotrimazole  | 1%       | Ointment    | 61.0                | 45.2| 14.0                 | 4.4        | 335.7           |
| Acyclovir     | 400 mg   | Tablet      | 24.0                | 13.1| 4.0                  | 6.0        | 500.0           |
| Lidocaine     | 2%       | Ointment    | 27.2                | 21.75| 15.0                 | 1.8        | 81.3            |
| Ketoconazole  | 2%       | Ointment    | 64.5                | 75.3| 18.0                 | 3.6        | 258.3           |
| Fluconazole   | 150 mg   | Tablet      | 13.3                | 4.75| 5.0                  | 2.7        | 166.0           |
| Ketoconazole  | 200 mg   | Tablet      | 24.3                | 22.05| 2.8                  | 8.7        | 767.9           |
| Chlorhexidine | 0.2%     | Mouth wash  | 47.5                | 25.0| 21.0                 | 2.3        | 126.2           |
shortage can thus be addressed by developing collaboration between resident primary care and dental practitioners. A major objective that needs to be fulfilled by both dentists and primary care physicians is to provide affordable and quality medicines. Physicians should prescribe low-cost drugs using resources like the national database on drug pricing. Physicians must update knowledge on various brands, their prices and discuss the affordability before prescribing to the patients. In the present paper, we found that there was very little availability of dental medicines and oral care products at different state medical commissions. This issue has to be represented to the stakeholders and the availability of medicines has to be increased at primary care setups across the country. Also, commonly used drugs for dental conditions have to be included in the Jan Aushadhi procurement lists so that they can be prescribed in public and private health sectors.

**Conclusion**

Oral health care is often considered an expensive arena and cost is an essential factor that prevents the patients from approaching the physicians at the very onset of a problem. This negligence leads to mushrooming of various infections that arise as sequela to chronic oral inflammation. To the best of our knowledge, there are no previous studies that have evaluated cost variations in drugs and oral care products prescribed for dental conditions. Such pharmacoeconomic studies can facilitate effective price regulations, provide alternate financial mechanisms, and thus pave way for universal health coverage for all.

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**Conflicts of interest**

There are no conflicts of interest.

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