

Prescription pattern of oral hydrocortisone by Indian healthcare professionals: An online questionnaire-based survey

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Objective. Adrenal insufficiency is predominantly managed by glucocorticoids, from which hydrocortisone is most frequently prescribed. However, limited data are available on prescription patterns among Indian healthcare professionals (HCPs). This study assessed the prescription practices of hydrocortisone among Indian HCPs and evaluated their awareness of tapering protocols and necessity for modified-release formulations of hydrocortisone.

Methods. This online questionnaire-based survey involved 300 HCPs across India who prescribe oral hydrocortisone for various endocrinological and non-endocrinological indications. Google Forms were used and survey was carried out over a period of two months. Only fully accomplished responses were included in the analysis and the response rate was calculated.

Results. The survey response rate was 84.27%. Among HCPs, 94.7% prescribed oral hydrocortisone with 47.5% using it often and 28.9% very often. Prescription frequency varied from 29.9% (prescribed once weekly) to 25.7% (two or more times weekly). Awareness of approved indications was high (96.8%). Tapering protocols were widely practiced (95.4%) often or very often by 82.7% HCPs. Hydrocortisone was mainly prescribed for primary adrenal insufficiency (77.5%), secondary adrenal insufficiency (63.0%), and congenital adrenal hyperplasia (55.6%). Frequent adverse events included hyperglycemia (43.3%) and weight gain (43.0%). Most HCPs (89.8%) felt need for sustained-release hydrocortisone, particularly for primary adrenal insufficiency (81.7%). Alternatives of hydrocortisone mainly included prednisolone (65.8%), prednisone (37.3%), and dexamethasone (21.8%).

Conclusion. Indian HCPs frequently prescribe oral hydrocortisone and are well-versed in tapering protocols. However, frequent adverse events and unmet needs emphasize strong demand for modified-release formulations, particularly for management of adrenal insufficiency.

Keywords: adrenal insufficiency, adverse drug reactions, hydrocortisone, modified-release formulations, prednisolone

Adrenal insufficiency, an endocrine disorder characterized by significantly deficient serum glucocorticoid levels, has a global prevalence of approximately

300 cases per million individuals (Rushworth and Torpy 2023) and Indian prevalence of 100 to 140 cases per million individuals (Sridhar et al. 2022). In these

patients, glucocorticoids remain the main therapy that results in quick symptomatic relief within hours (Wondmkun and Ayele 2021). Hydrocortisone serves as the chief therapeutic glucocorticoid and is primarily utilized in the management of conditions requiring glucocorticoid supplementation including acute and chronic adrenal insufficiency and congenital adrenal hyperplasia (Neumann et al. 2025). Beyond adrenal insufficiency, glucocorticoids are broadly prescribed in inflammatory and autoimmune disorders owing to their potent anti-inflammatory effects (Coutinho and Chapman 2011).

Irrespective of underlying etiology, treatment typically starts with high doses followed by tapering doses for decreasing the risk of relapse (Wondmkun and Ayele 2021). The usual hydrocortisone regimen followed is 10 mg in the morning, 5 mg in the afternoon, and 2.5 mg in the evening (Priya et al. 2024). However, such doses need to be tailored according to individual responses given that routine cortisol generation through hypothalamus-pituitary-adrenal (HPA) axis varies from 10 to 30 mg per day (Caetano and Malchoff 2022). Physiologically, cortisol secretion tracks a circadian rhythm peaking during early morning and falling drastically by midnight. Replicating this diurnal variation remains difficult with conventional hydrocortisone formulations, specifically given patients' requirement for increased serum cortisol during daytime activity (Steintorsdottir et al. 2025). Moreover, hydrocortisone requires frequent dosing due to short duration of action (Rushworth and Torpy 2023), thus there is a need for modified- or sustained-release hydrocortisone formulation.

Though hydrocortisone is predominantly recognized as glucocorticoid, it also possesses an equivalent mineralocorticoid activity (Alvarez de la Rosa et al. 2024). Chemical variations of hydrocortisone have yielded alternative medications with improved glucocorticoid efficacy and reduced mineralocorticoid effects including prednisolone and dexamethasone (Seth and Aggarwal 2004). However, both of them are associated with various adverse events (Bugrul and Murat 2025). Moreover, adverse events associated with hydrocortisone therapy are often linked to dose variability and prescriber knowledge regarding tapering protocols (Bugrul and Murat 2025). Given that hydrocortisone is frequently prescribed by healthcare practitioners (HCPs) across varied specialties, a focused survey examining the prescribing pattern of hydrocortisone and its clinical applications among HCPs remains limited (Abad-Santos et al. 2002; Llahana et al. 2025; Wallace et al.

2025), particularly in the Indian context (Mathew et al. 2021). Thus, this study evaluated the prescription practices of hydrocortisone among HCPs and assessed their awareness of tapering dose protocols and necessity for modified-release formulations of hydrocortisone.

Materials and Methods

Study design and ethics. This cross-sectional multiple-response online questionnaire-based survey was performed over a period of two months (from June 18, 2025 to August 17, 2025). The study was approved by the Central Independent Ethics Committee (Pune, Maharashtra) (No. CIEC/2025/0197; dated Jun 17, 2025) and informed consent was obtained from the HCPs after explaining the purpose and benefits of the study.

Study population. The survey involved 300 HCPs across India who prescribed oral hydrocortisone for various endocrinological (including primary, secondary, and glucocorticoid-induced adrenal insufficiency), as well as non-endocrinological indications in their routine practice. HCPs were excluded if they treated fewer than five relevant patients per year who required a prescription for oral hydrocortisone did not prescribe oral hydrocortisone or did not respond to all survey questionnaires.

Study procedure. A structured questionnaire was developed to evaluate the knowledge and practice of HCPs associated with use of oral hydrocortisone across therapy areas. Questions were designed as multiple-choice or dichotomous (male/female and yes/no) to facilitate response standardization. The HCPs prescribing oral hydrocortisone for various endocrine and non-endocrine indications were recruited via convenience sampling from professional networks and their referrals and invited to take part in the survey. The HCPs who accepted the invitation were briefed about the study details and asked to sign an informed consent form. After obtaining the consent, the HCPs were asked to complete an online questionnaire-based survey. This online questionnaire-based survey was conducted using Google Forms and only fully accomplished responses were included in the analysis. On completion of the survey, the response rate was calculated, and data was analyzed.

The survey collected demographic and professional information of HCPs including their age, sex, location of practice, specialization, years of clinical practice, and place of work. Moreover, information regarding prescription of oral hydrocortisone including

therapeutic use, awareness of approved indications, prescription pattern and frequency, practice of tapering dose protocol and its requirement in clinical practice, use in various clinical conditions, adverse events observed with oral hydrocortisone use, need for a modified- or sustained-release formulation of oral hydrocortisone and their use in various clinical conditions, and alternatives for oral hydrocortisone used in clinical practice, was collected.

Sample size estimation. The survey response rate was determined by dividing the number of HCPs who responded by the total number of HCPs who participated. The 80% or greater response rate was taken into consideration for this survey (Booker *et al.* 2021). Telephonic and in-person informed consent was obtained and questionnaire was sent to 356 HCPs, of which 300 completed the survey, resulting in a response rate of 84.27%.

Statistical analysis. Descriptive statistics were used. Continuous variables were represented as mean values $\pm$ standard deviation (SD) or median value with range, while categorical variables were represented as percentages.

Table 1

Demographic and clinical characteristics

Characteristics	n = 284
Age (years) [mean $\pm$ SD (range)]	44.7 $\pm$ 9.1 (26–84)
Gender [n (%)]	
Male	251 (88.4)
Female	33 (11.6)
City [n (%)]	
Metropolitan	41 (14.4)
Non-metropolitan	243 (85.6)
Specialty [n (%)]	
Endocrinology	164 (57.7)
Internal medicine	112 (39.4)
Cardiology	5 (1.8)
Allergy	2 (0.7)
Pediatrics	1 (0.4)
Years of clinical practice [mean $\pm$ SD (range)]	15.2 $\pm$ 8.7 (2–58)
Place of work [n (%)]	
Private clinic	123 (43.3)
Corporate hospital	115 (40.5)
Government hospital	37 (13.0)
Primary health care center	9 (3.2)

Results

Of 300 HCPs, 284 (94.7%) prescribed hydrocortisone in their clinical practice and were included into analysis. The HCPs were predominantly male (88.4%) with a mean age 44.7 $\pm$ 9.1 years (range: 26–84 years). Most HCPs practiced in non-metropolitan areas (85.6%) and specialized in endocrinology (57.7%) as well as internal medicine (39.4%). The average experience of clinical practice was 15.2 $\pm$ 8.7 years (range: 2–58 years). The HCPs primarily practiced in private clinics (43.3%) and corporate hospitals (40.5%) (Table 1).

A vast majority of HCPs (94.7%) reported prescribing oral hydrocortisone in their practice with 47.5% using it often and 28.9% very often. Prescription frequency varied with 29.9% prescribing it once a week and 25.7% two or more times a week, while 6.3% prescribed oral hydrocortisone daily.

Table 2

Prescription patterns, awareness and tapering protocols of oral hydrocortisone

Characteristics	n (%)
How often is oral hydrocortisone prescribed in clinical practice?	
Often	135 (47.5)
Very Often	82 (28.9)
Not so often	47 (16.5)
Rarely	20 (7.1)
What is the frequency of oral hydrocortisone prescription in clinical practice?	
Every day	18 (6.3)
Once a month	56 (19.7)
Once a week	85 (29.9)
Two or more times a week	73 (25.7)
Twice a month	52 (18.3)
Are you aware of approved indications of oral hydrocortisone in India?	
Yes	275 (96.8)
No	9 (3.2)
Do you follow tapering dose protocols?	
Yes	271 (95.4)
No	13 (4.6)
How often is tapering required in clinical practice?	
Often	137 (48.2)
Very Often	98 (34.5)
Not so often	33 (11.6)
Rarely	16 (5.6)

Awareness of approved indications was high (96.8%). Most of the HCPs followed tapering dose protocols while withdrawing hydrocortisone therapy (95.4%) with 48.2% practicing it often and 34.5% very often, while 5.6% indicated dose tapering is rarely required in clinical practice (Table 2).

The HCPs primarily prescribed oral hydrocortisone for primary adrenal insufficiency (77.5%), secondary adrenal insufficiency (63.0%), congenital adrenal hyperplasia (55.6%), and steroid dependence (44.0%). The most common adverse events reported were hyperglycemia (43.3%), weight gain (43.0%), gastrointestinal discomfort (36.6%), and hypertension (32.4%), while 21.5% reported no adverse events. A large majority (89.8%) expressed the need for a modified- or sustained-release hydrocortisone formulation, especially for primary adrenal insufficiency (81.7%), congenital adrenal hyperplasia (49.6%), secondary adrenal insufficiency (44.0%), and steroid dependence (43.7%) (Table 3).

Prednisolone (65.8%) was the most frequently used alternative to oral hydrocortisone, followed by prednisone (37.3%) and dexamethasone (21.8%) (Table 4).

Discussion

The principal findings of the study revealed that HCPs predominantly prescribed oral hydrocortisone had high awareness of its approved indications and adhered to tapering dose protocol. Common clinical indications included adrenal insufficiency and congenital adrenal hyperplasia with high incidence of reported adverse events. Notably, a high proportion of HCPs felt the need for modified- or sustained-release oral hydrocortisone formulations. Moreover, HCPs used prednisolone, prednisone, and dexamethasone as alternatives of oral hydrocortisone.

The study findings suggest substantial inclination towards the use of oral hydrocortisone among both

Table 3
Clinical indications, adverse events, and need for modified/sustained release formulation of oral hydrocortisone

Characteristics	n (%)	Characteristics	n (%)
In which clinical conditions is oral hydrocortisone generally prescribed in clinical practice?		Cushing's syndrome	42 (14.8)
Primary adrenal insufficiency	220 (77.5)	Allergic reaction	1 (0.4)
Secondary adrenal insufficiency	179 (63.0)	Blurred vision	1 (0.4)
Congenital adrenal hyperplasia	158 (55.6)	Fast heartbeat	1 (0.4)
Steroid dependence	125 (44.0)	Weakness	1 (0.4)
Allergic diseases	69 (24.3)	Gastrointestinal bleed	1 (0.4)
Asthma	63 (22.2)	Diabetes	1 (0.4)
Urticaria	42 (14.8)	Do you feel the need for a modified/sustained release formulation of oral hydrocortisone?	
Rheumatic diseases	36 (12.7)	Yes	255 (89.8)
Ulcerative colitis	29 (10.2)	No	29 (10.2)
Crohn's disease	22 (7.7)	In which clinical conditions would the modified/sustained release oral hydrocortisone be prescribed in clinical practice?	
Atopic dermatitis	1 (0.4)	Primary adrenal insufficiency	232 (81.7)
Exogenous Cushing's syndrome	1 (0.4)	Congenital adrenal hyperplasia	141 (49.6)
Which adverse events are observed with oral hydrocortisone in clinical practice?		Secondary adrenal insufficiency	125 (44.0)
Hyperglycemia	123 (43.3)	Steroid dependence	124 (43.7)
Weight gain	122 (43.0)	Asthma	54 (19.0)
Gastrointestinal discomfort	104 (36.6)	Allergic diseases	51 (17.9)
Hypertension	92 (32.4)	Rheumatic diseases	29 (10.2)
No adverse events	61 (21.5)	Ulcerative colitis	28 (9.9)
Oedema	55 (19.4)	Urticaria	27 (9.5)
Mood change	46 (16.2)	Crohn's disease	22 (7.7)

endocrinology and non-endocrinology HCPs. The variable frequency of prescriptions points toward differences in patient requirements, clinical settings, and conditions being managed. This aligns with the findings of Abad-Santos *et al.* (2002) who have reported that majority of physicians prescribed oral hydrocortisone for varied conditions. Additionally, Chua *et al.* (2025) have highlighted the distinctions in self-management practices for patients with adrenal insufficiency suggesting that HCPs adapt their prescribing habits depending upon the requirement of individual patients. Increased awareness of approved indications highlights the impact of educational initiatives in endocrinology and steroid replacement therapy, while stressing significant complications associated with management of adrenal insufficiency and associated disorders. This is in agreement with available literature suggesting that increased awareness would allow HCPs to better determine the risks associated with use of oral hydrocortisone and may also prompt further queries as to their adequate use (Rifaei *et al.* 2025; Wallace *et al.* 2025). Additionally, the finding that majority of HCPs adhere to tapering protocols is remarkable aligning with previous studies suggesting that appropriate tapering strategies can significantly reduce challenges associated with long-term glucocorticoids use (Alam *et al.* 2023). Thus, constant adherence to tapering protocol prevents potential adverse events associated with unexpected termination of glucocorticoids.

The survey findings regarding clinical indications, adverse events, and the requirements for modified- or sustained-release formulations highlighted important aspects of glucocorticoid therapy use among HCPs. A substantial proportion of HCPs prescribe hydrocortisone mainly for primary adrenal insufficiency and congenital adrenal hyperplasia depicting its essential role in managing such conditions. Similarly, previous studies indicating that oral hydrocortisone is prescribed mainly for primary adrenal insufficiency followed by congenital adrenal hyperplasia (Abad-Santos *et al.* 2002). The prevalence of these conditions emphasizes the dependency of patients on effective glucocorticoid therapy, as noted in previous studies, thus indicating that optimal management can significantly reduce morbidity and enhance the quality of life among affected individuals (Ekman *et al.* 2014). The highly prevalent adverse events including hyperglycemia, weight gain, and gastrointestinal discomfort, suggest significant risks associated with conventional hydrocortisone therapy due to fluctuating cortisol levels. These adverse events are consistent with previous studies, which have

Table 4
Alternatives to oral hydrocortisone (n=300)

Characteristics	n (%)
What oral hydrocortisone alternatives are used in clinical practice?	
Prednisolone	187 (65.8)
Prednisone	106 (37.3)
Dexamethasone	62 (21.8)
Deflazacort	2 (0.7)
None	1 (0.4)

reported similar adverse events related to glucocorticoid therapy, thus encouraging use of alternatives or modified-release preparations of oral hydrocortisone to minimize these adverse events (Abad-Santos *et al.* 2002; Ekman *et al.* 2014; Wallace *et al.* 2025). The marked proportion of hypertension and mood changes further emphasizes the need for vigilant monitoring and poor adverse event management associated with current glucocorticoid replacement strategies (Oprea *et al.* 2019).

Adrenal insufficiency and congenital adrenal hyperplasia are associated with the need for physiological replacement of glucocorticoids. We observed that most HCPs expressed the need for modified- or sustained-release formulations, principally for primary adrenal insufficiency and congenital adrenal hyperplasia, thus reflecting overall limitations associated with the conventional formulations. Literature suggests that modified-release hydrocortisone can thoroughly impersonate the physiological circadian rhythm of cortisol secretion vital for enhancing therapeutic effects (Ross *et al.* 2025). Moreover, introducing such formulations could minimize the frequency of adverse events and progressively increase the overall patient adherence due to more stable pharmacokinetic profile (Neumann *et al.* 2025). Emerging evidence suggests that modified-release hydrocortisone leads to diurnal cortisol levels similar to normal diurnal cortisol secretion that results in improved disease control along with reduced steroid dose over time (Merke *et al.* 2021), thereby decreasing the risk of adverse events. This aligns with the findings of previous studies that indicate that modified-release hydrocortisone is associated with advantages in regulating metabolic parameters (Whitaker *et al.* 2014) and improved quality of life (Isidori *et al.* 2018). Such advancements in hydrocortisone therapy warrant consideration by HCPs not only from the point of view of efficacy, but

also for the improved quality of life as provided by these formulations.

The present survey revealed that prednisolone is mainly prescribed as an alternative to oral hydrocortisone followed by use of prednisone and dexamethasone, thus pointing towards notable flexibility among HCPs in managing adrenal insufficiency and associated diseases. This is consistent with previous studies suggesting that prednisolone is predominantly prescribed for management of adrenal insufficiency (Abad-Santos et al. 2002; Wondmkun and Ayele 2021). The inconsistency in glucocorticoid selection is affected by various clinical conditions as well as pharmacokinetic properties and adverse event profile of each medication. Prednisolone, for instance, is utilized during situations demanding quick therapeutic effects, such as acute allergic reactions due to its rapid onset of action (Mahlab-Guri et al. 2023). The use of such alternatives may reflect clinical experiences where patients tolerate other glucocorticoids more efficiently than hydrocortisone. This aligns with studies stating high preference of patients for alternative agents such as prednisone in comparison to hydrocortisone (Bugrul and Murat 2025). Another important factor, while considering alternative treatments, is the awareness among HCPs regarding potential adverse events associated with long-term hydrocortisone use (Tavares et al. 2024). Long-term glucocorticoid use (dexamethasone and prednisolone) causes suppression of the HPA axis resulting in adrenal insufficiency and making it difficult to withdraw glucocorticoid therapy abruptly (Khalili and Burt 2025). Moreover, evaluating individual variability in glucocorticoid response and their potential adverse events strengthens the rationale for alternative methods for managing adrenal insufficiency and associated disorders. For instance, dexamethasone might be preferred in severe inflammatory conditions, where potent anti-inflammatory effects are required without mineralocorticoid activity inherent to hydrocortisone (Selvido et al. 2021). The modified-release formulations provide morning bolus dose with basal cover, thus mimicking physiological cortisol release. These findings encourage HCPs to explore alternative hydrocortisone formulations with enhanced safety profile or to individualize therapy based on patient response (Wallace et al. 2025).

The study has various limitations, which require consideration. First, dependency on self-reported data from HCPs may generate recall bias potentially affecting the accuracy of the reported prescription

habits and awareness levels. Moreover, the reported adverse events appear to be based on recall or perception rather than documented incidence. Second, cross-sectional study design may restrict the ability to establish causal association, as it captures relations at a single point, rather than examining differences in practice or long-term implications on patient outcomes. Third, a convenience sampling approach was used, where HCPs were recruited through professional networks and their referrals. Thus, selection bias may have been introduced and the findings may not represent the overall Indian HCPs. Fourth, demographic diversity of the respondents, disproportionately high proportion of males (88.4%) and those practicing in non-metropolitan regions (85.6%), restrict representativeness of broader HCP population, thus limiting the generalizability of the findings. Fifth, this survey used factual experience-based questions related to prescription practices and not psychometric scales measuring latent constructs, thus survey questionnaire was not validated. Sixth, the sample size was small and formal power analysis was not performed. Moreover, this was an exploratory descriptive survey without a prior hypothesis and subgroup comparisons were not performed as sample size was not powered enough to reach definitive conclusion. Lastly, the survey did not investigate the clinical outcomes of patients receiving hydrocortisone offering deeper insights into the effectiveness and suitability of the prescribed therapies nor did it explore the reasons behind selecting alternative glucocorticoids providing their influence on clinical decision-making.

Conclusion

The oral hydrocortisone is frequently prescribed by Indian HCPs, primarily for adrenal insufficiency and related conditions, with majority adhering to tapering dose protocols, thus supporting patient safety. Though the HCPs had high awareness of approved indications, adverse events such as hyperglycemia, weight gain, and hypertension are frequent. These findings suggest that the majority of surveyed HCPs perceive an unmet clinical need for modified- or sustained-release hydrocortisone formulations, which they believe may improve patient outcomes and quality of life, particularly in those with primary adrenal insufficiency, congenital adrenal hyperplasia, and steroid dependence. Moreover, agents such as prednisolone, prednisone, and dexamethasone are frequently used as alternative to oral hydrocortisone, thereby highlighting therapeutic flexibility.

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