Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Pediatric anogenital warts: A multicenter retrospective study of clinical features, modes of transmission, and treatment patterns

Malorie Veyrieres
Centre Hospitalier Universitaire de Tours
Alice Phan
Hôpital Femme Mère Enfant
Ruxanda Moschoi
Centre Hospitalier Universitaire de Nice
Jasmine Flament
Centre Hospitalier Universitaire de Rouen
Eve Puzenat
Centre Hospitalier Universitaire de Besançon
Emmanuel Mahé
Hospital Victor Dupouy
Valentine Heidelberger
Centre hospitalier Robert-Ballanger
Maud Steff-Naud
Centre hospitalier Robert-Ballanger
Simon Benkimoun
Assistance Publique-Hôpitaux de Marseille, Hospital of Timone
Marie Chinazzo
Centre Hospitalier Universitaire de Tours
Laura Poujade
Assistance Publique-Hôpitaux de Marseille, Hospital of Timone
Patricia Le Nouail
Assistance Publique-Hôpitaux de Marseille, Hospital of Timone
Marie Bachelerie
Centre Hospitalier Universitaire de Clermont-Ferrand
Maella Severino-Freire
Centre Hospitalier Universitaire de Toulouse
Christine Labrèze
Centre Hospitalier Universitaire de Bordeaux
Juliette Miquel
Centre Hospitalier Universitaire de La Réunion
Ingrid Kupfer-Bessaguet
Georges Renon Hospital
Christine Chiaverini
Centre Hospitalier Universitaire de Nice

Stéphanie Mallet
Assistance Publique-Hôpitaux de Marseille, Hospital of Timone
Thomas Hubiche
Centre Hospitalier Universitaire de Nice
Annabel Maruani
annabel.maruani@univ-tours.fr

Centre Hospitalier Universitaire de Tours

Research Article

Keywords: HPV, anogenital warts, condylomas, pediatric, imiquimod

Posted Date: November 1st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11242588/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Anogenital warts are benign HPV-related lesions that are uncommon in children, with controversial modes of transmission and limited evidence regarding their management. We conducted a multicenter retrospective study of 63 children diagnosed with anogenital warts across 14 French hospital dermatology departments to describe their clinical characteristics, presumed modes of transmission, and treatment patterns. Anogenital warts predominantly affected young girls (43 girls [68.3%], median age at diagnosis: 4.0 years) and the perianal area; no cases of sexual abuse were identified, while hetero-inoculation was considered the most likely mode of transmission in nearly half of evaluable cases. Imiquimod was the most frequently prescribed first-line treatment (45/63, 71.4%), with a median treatment duration of 8 weeks; among 45 evaluable children, 22 (48.9%) achieved complete clearance within 8 weeks. As second-line treatment, podophyllotoxin was the most frequently prescribed therapy (n = 6), followed by imiquimod (n = 4) and cryotherapy (n = 2). Overall, treatments were well tolerated, with no serious adverse events reported. Among the 45 children who received imiquimod with evaluable safety data, local adverse events occurred in 21 (46.7%). The frequent off-label use of imiquimod underscores the need for dedicated pediatric studies and evidence-based treatment recommendations.

What is Known

- *HPV-related lesions are uncommon in children, with controversial modes of transmission and limited evidence to guide their management.*
- *Available treatments are not approved for children and target visible lesions, with no established recommendations for managing HPV infection.*

What is New:

- *In our cohort of 63 children, the median age was 4 years; the most likely modes of transmission were autoinoculation from existing warts and inoculation by parents, with no cases of sexual abuse identified.*
- *Imiquimod emerged as the most frequently used first-line treatment despite its off-label use in children.*

Text

Anogenital warts are widespread benign lesions caused by human papillomavirus (HPV) infection. More than 200 HPV genotypes have been identified. While anogenital warts in adults are predominantly associated with mucosal HPV 6 and 11, cutaneous HPV genotypes may also be detected in children (1, 2). In children, the mode of transmission remains controversial and may involve three recognized routes: vertical transmission (in utero or during delivery) (3), horizontal non-sexual transmission through auto- or heteroinoculation (e.g., from common hand warts), and sexual transmission, which raises concerns about possible child abuse. The relative contribution of these routes varies considerably across studies (4).

Their course in children is often favorable, with spontaneous resolution reported in approximately 70% of cases within one year and 90% within two years (5). Treatment aims to remove visible lesions rather than eradicate HPV infection. Options include topical agents such as imiquimod and podophyllotoxin, and physical procedures including cryotherapy, laser therapy, and surgical removal. However, treatments routinely used in adults are not approved for children, and physical procedures may be difficult or painful in children. Consequently, no clearly established pediatric therapeutic hierarchy exists.

We aimed to investigate the clinical course and management of pediatric anogenital warts in routine practice, including clinical characteristics, presumed modes of transmission, and treatment patterns.

Methods

Study design and setting

This was a retrospective, observational, multicenter study conducted in 14 French hospital dermatology departments specializing in pediatric dermatology. The study was conducted between 30 September 2010 and 16 June 2026. The protocol was approved by the Ethics Committee for Human Research of the University Hospital of Tours (approval no. #2025 058). In accordance with French regulations, parents or legal guardians received written information about the study and were given the opportunity to object to the use of their child's data.

Participants

Eligible participants were children < 18 years with at least one clinically diagnosed anogenital wart (genital, perineal, or anal), assessed by a hospital-based pediatric dermatologist. Children with an uncertain diagnosis or whose parents or legal guardians objected to data use were excluded.

Data sources, variables and outcomes

Data were collected using standardized electronic case report forms and included demographic and clinical characteristics, immunosuppression, extragenital warts in the child, parental cutaneous or anogenital warts, investigations and assessment of suspected sexual abuse, and treatment regimen, duration and tolerance. Treatment response was classified as complete response (no clinical residual lesion), partial response (decrease wart number), no response (stable disease), worsening (increased wart number).

Bias

Standardized predefined variables were used to limit information bias, and families were contacted by telephone to clarify missing or ambiguous data. The retrospective design nevertheless resulted in missing data for some variables.

Statistical analysis

Descriptive analyses were performed. Categorical variables are presented as frequencies and percentages, whereas continuous variables are reported as medians with interquartile ranges (IQR, Q1–Q3). Calculations were performed using Numbers, version 14.1 (Apple Inc., Cupertino, CA, USA).

Results

Patient characteristics (Table 1)

Table 1
Baseline demographic and clinical characteristics of the study population and anogenital warts (n = 63)

Variables	Value, n (%)	Missing data, n
PATIENT CHARACTERISTICS		
Sex		
Female	43 (68.3)	0
Male	20 (31.7)	
Age at diagnosis, years		
Median(Q1–Q3)	4 (2.5–5.8)	0
Range	0.3–14.2	
Time from symptom onset to diagnosis		
< 3 months	20 (37.1)	9
3–6 months	12 (22.2)	
> 6 months	22 (40.7)	
MEDICAL HISTORY		
Relevant medical history	12 (19.0)	
Atopic dermatitis	4 (6.3)	0
Leukemia	1 (1.6)	
History of HPV-related lesions		
Extragenital warts in the child*	10 (15.9)	0
Parental extragenital warts*	11 (20.8)	10
Parental anogenital warts	10 (20.8)	15
CLINICAL DESCRIPTION		
Number of lesions		
≤ 10	20 (55.6)	27
> 10	16 (44.4)	
Anatomical distribution**		
Perianal involvement only	47 (77.0)	2
Genital involvement only	5 (8.2)	
Anogenital involvement	9 (14.8)	
Clinical symptoms***		

**Extragenital warts included warts on the hands and/or feet.*

***Perianal involvement included lesions on the perianal region, anal margin, gluteal region, and intergluteal fold. Combined anogenital involvement was defined as the presence of both perianal and genital lesions.*

****Patients could report more than one symptom.*

Variables	Value, n (%)	Missing data, n
PATIENT CHARACTERISTICS		
Asymptomatic	18 (51.4)	28
Pruritus	10 (28.6)	
Pain	6 (17.1)	
Bleeding	2 (5.7)	
Constipation	1 (2.9)	
Psychological distress	1 (2.9)	
**Extragenital warts included warts on the hands and/or feet.*		
***Perianal involvement included lesions on the perianal region, anal margin, gluteal region, and intergluteal fold. Combined anogenital involvement was defined as the presence of both perianal and genital lesions.*		
****Patients could report more than one symptom.*		

Table 2. Efficacy and safety of treatments used in children with anogenital warts (n = 63)

Treatment	Efficacy assessment, n*	Complete response, n (%)**	Partial response, n (%)**	No response, n (%)**	Worsening, n (%)**	Safety assessment, n	Local adverse events, n (%)***
Imiquimod (n = 51)	45	22 (48.9)	10 (22.2)	12 (26.7)	1 (2.2)	45	21 (46.7)
Podophyllotoxin (n = 13)	7	1 (14.3)	0 (0.0)	5 (71.4)	1 (14.3)	7	1 (14.3)
5-Fluorouracil (n = 2)	2	0 (0.0)	1 (50.0)	1 (50.0)	0 (0.0)	2	2 (100.0)
Cryotherapy (n = 10)	7	1 (14.3)	1 (14.3)	3 (42.9)	2 (28.6)	8	3 (37.5)
Laser therapy (n = 1)	1	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	1	0 (0.0)
Surgical removal (n = 5)	5	1 (20.0)	1 (20.0)	1 (20.0)	2 (40.0)	5	0 (0.0)
Total	**67**	**25**	**14**	**22**	**6**	**68**	**27**

**Number of patients who received each treatment across all treatment lines. Patients could be included in more than one treatment category.*

***Percentages for treatment response were calculated using the number of patients with available efficacy assessment.*

****Percentages for adverse events were calculated using the number of patients with available safety assessment. No systemic adverse event was reported.*

A total of 63 children with anogenital warts were included (43 girls [68.3%] and 20 boys [31.7%]; female-to-male ratio 2:1). The median age at diagnosis was 4.0 years (IQR, 2.5–5.8; range 0.3–14.2), with 11 children (17.5%) aged 2 years or younger. One child was immunosuppressed (a 5-year-old boy with acute leukemia). Concomitant extragenital warts involving the hands and/or feet were reported in 10 children (15.9%). Parental warts were also reported: 11 of 53 children (20.8%) had at least one parent with extragenital warts, and 10 of 48 (20.8%) had at least one parent with a history of anogenital warts. This history of parental anogenital warts concerned the mother in 2 cases, the father in 3, and both parents in 2; the affected parent was not specified in 3 cases.

Clinical presentation (Table 1)

Isolated perianal involvement was the most common presentation, occurring in 47 of 61 children (77.0%), followed by combined perianal and genital lesions (14.8%) and isolated genital involvement (8.2%). Lesions count was documented in 36 children: 20 (55.6%) had 10 or fewer lesions and 16 (44.4%) had more than 10 lesions. Among the 35 children with documented clinical impact, 18 (51.4%) were asymptomatic. When present, symptoms were mainly pruritus (n = 10) and pain (n = 6). Among the 54 children with available data, 22 (40.7%) were diagnosed more than 6 months after symptom onset.

Investigations, transmission assessment and safeguarding

Complementary investigations were performed selectively according to the clinical context. Among the 36 children with available data, 5 (13.9%) underwent screening for sexually transmitted infections (STIs), among whom 3 (8.3%) were hospitalized for multidisciplinary assessment, including psychological evaluation and social work assessment. Three children underwent immunodeficiency investigations. All STI screening and immunodeficiency investigations were negative. No case of sexual abuse was confirmed.

Therapeutic management and efficacy outcomes (Fig. 1)

Imiquimod was the preferred first-line treatment, prescribed in 45 of 63 children (71.4%), while clinical observation was the second most common first-line approach (n = 6, 9.5%). As second-line treatment, podophyllotoxin was the most frequently prescribed therapy (n = 6), followed by imiquimod (n = 4) and cryotherapy (n = 2). One child received HPV vaccination as an adjuvant therapy.

Across all treatment-lines, imiquimod was the most commonly used treatment, prescribed in 51 of 63 children (81%). The median treatment duration was 8 weeks (IQR, 5–15), and the most frequently used regimen was three applications per week. Among the 45 children out of 51 treated with imiquimod who had evaluable follow-up at the end of treatment, 22 (48.9%) achieved a complete response within the 8 weeks. Clinical observation resulted in spontaneous complete resolution in all four children with available follow-up data, after a median of 45 days (IQR, 43.75–46.25).

Overall, treatments were well tolerated, with no serious adverse events (AEs) reported. Among the 45 children who received imiquimod with evaluable safety data, local AEs occurred in 21 (46.7%).

Discussion

Key results

In this multicenter cohort, pediatric anogenital warts predominantly affected young girls and the perianal area. No sexual abuse was identified, while heteroinoculation was considered the most likely route of transmission in nearly

half of evaluable cases. Management strategies were heterogeneous, but imiquimod predominated despite its off-label status in children.

Interpretation

Our population was similar to previous pediatric cohorts regarding young age, female predominance, and frequent perianal involvement (6, 7). Marcoux et al. reported onset between 2 and 6 years in 62% of children, while female predominance and perianal localization have also been consistently described (7). Perianal predominance may be facilitated by local maceration and heteroinoculation during routine hygiene. Half of children were asymptomatic and over 40% were diagnosed after six months, suggesting that the diagnosis may often be overlooked.

Immunosuppression was uncommon, with only one child with acute leukemia. However, severe or treatment-resistant anogenital warts may occur in immunocompromised children or reveal a primary immunodeficiency (8). Immunological investigations should therefore be performed in extensive or treatment-refractory disease.

Heteroinoculation, mainly supported by parental extragenital or anogenital warts, was the most frequently suspected route of transmission, whereas autoinoculation was uncommon. No case of sexual abuse was identified in our cohort. However, sexual abuse in children may be underrecognized, particularly in the absence of disclosure or other suggestive findings (9). Anogenital warts alone should therefore not be considered evidence of sexual abuse but interpreted according to the child's age, clinical findings, family history, and social context (9).

Therapeutic management was heterogeneous, reflecting the lack of standardized pediatric recommendations. Clinical observation was used in six children (9.5%), with spontaneous complete regression in all four with available follow-up after a median of 45 days, supporting observation for limited, asymptomatic lesions (5–7), Although limited by the small number of cases, this supports observation as an option for asymptomatic lesions. Topical therapies predominated over physical procedures, likely reflecting their non-invasive nature in young children (10). Imiquimod was the most frequently used treatment, achieving complete response in 48.9% of evaluable children after a median of 8 weeks and an overall response rate of 71.1%. Adverse events occurred in 46.7% but were predominantly mild and local (10). Reported efficacy ranges widely, from 11% to 88% in French recommendations (11) and 35% to 65% in IUSTI-European guidelines (12), largely based on adult data. Our findings support imiquimod as a practical, generally well-tolerated pediatric option. One child received HPV vaccination as adjunctive therapy; although currently prophylactic, its potential therapeutic role in anogenital warts warrants further investigation.

Limitations and strengths

Limitations include the retrospective design, missing data, non-standardized treatment selection and follow-up, lack of information on siblings, limited ability to compare treatment efficacy, and recruitment from specialized departments, potentially limiting generalizability. Strengths include the multicenter design, relatively large pediatric cohort, and standardized data collection.

Conclusion

This real-world study highlights the treatment approach observed in clinical practice for pediatric anogenital warts: observation for asymptomatic lesions, imiquimod as the predominant first-line therapy when treatment was considered necessary, podophyllotoxin mainly as second-line therapy, and physical procedures in later lines. The frequent off-label use of imiquimod highlights the lack of pediatric trials and evidence-based recommendations and the need for dedicated studies and appropriate regulatory approval.

Declarations

Funding information: None.

Conflicts of Interest: None.

Ethical Approval: Reviewed and approved by the Ethics Committee for Human Research of the University Hospital of Tours; approval **#2025 058**.

Ethics statement: All parents or legal guardians provided both oral and written informed consent to participate in the trial and to allow publication of their child's data.

Data availability statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Funding: No financial or non-financial benefits have been received or will be received from any party related directly or indirectly to the subject of this article.

Contributors' statement: Alice Phan and Annabel Maruani conceived and designed the study. All authors participated as investigators and contributed to data collection. Malorie Veyrieres drafted the manuscript. All authors critically reviewed the manuscript, approved its final version, and agreed to be accountable for the work.

Declaration of generative AI and AI-assisted technologies in the writing process: The authors did not use generative AI or AI-assisted technologies for the writing of the manuscript, data collection, data analysis, or interpretation of the results. ChatGPT (OpenAI) was used solely to assist in the graphical presentation of Figure 1.

Acknowledgement

The authors gratefully acknowledge the contribution of the late Professor Franck Boralevi, from Bordeaux University Hospital, who participated in the early stages of this study. We wish to honour his memory.

Data Availability

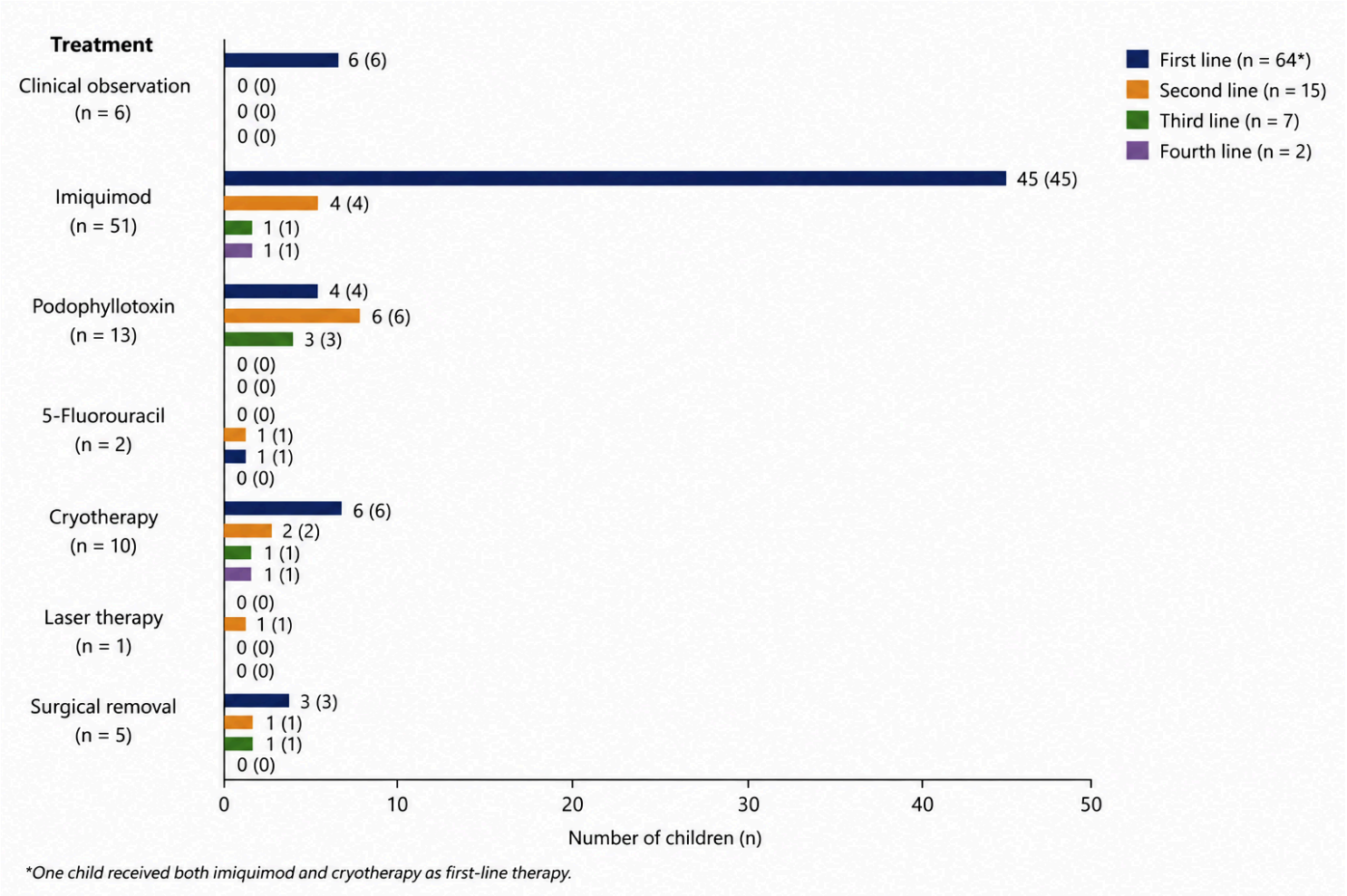
The datasets generated and analyzed during the current study are not publicly available due to privacy and confidentiality considerations regarding the participants' medical data. Data may be available from the corresponding author upon reasonable request, subject to appropriate ethical, legal, and institutional approvals.

References

1. Tomecka P, Karwowska A, Kuźnicki J, Skinderowicz K, Wojno A, Markut K et al (2025) HPV infection in children and adolescents - A comprehensive review. J Clin Med 14:2425. 10.3390/jcm14072425
2. Braun SA, Silling S, Schloer SM, Hofmann SC, Fritzen B, Oellig F et al (2021) Human papillomavirus-type distribution in anogenital lesions of prepubertal children. J Eur Acad Dermatol Venereol 35:1219–1225. 10.1111/jdv.17114
3. Nantel É, Mayrand MH, Audibert F, Niyibizi J, Brassard P, Laporte L et al (2024) Association between the mode of delivery and vertical transmission of human papillomavirus. Viruses 16:303. 10.3390/v16020303
4. Awasthi S, Ornelas J, Armstrong A, Johnson JA, Eisen DB (2021) Anogenital warts and relationship to child sexual abuse: systematic review and meta-analysis. Pediatr Dermatol 38:842–850. 10.1111/pde.14650

5. Herzum A, Ciccarese G, Occella C, Gariazzo L, Pastorino C, Trave I et al (2023) Treatment of pediatric anogenital warts in the era of HPV-vaccine: a literature review. J Clin Med 12:4230. 10.3390/jcm12134230
6. Costa-Silva M, Azevedo F, Lisboa C (2018) Anogenital warts in children: analysis of a cohort of 34 prepubertal children. Pediatr Dermatol 35:e325–e327. 10.1111/pde.13543
7. Marcoux D, Nadeau K, McCuaig C, Powell J, Oligny LL (2006) Pediatric anogenital warts: a 7-year review of children referred to a tertiary-care hospital in Montreal, Canada. Pediatr Dermatol 23:199–207. 10.1111/j.1525-1470.2006.00218.x
8. Zampella J, Cohen B (2022) Consideration of underlying immunodeficiency in refractory or recalcitrant warts: a review of the literature. Skin Health Dis 2:e98. 10.1002/ski2.98
9. Kellogg ND, Farst KJ, Adams JA (2023) Interpretation of medical findings in suspected child sexual abuse: An update for 2023. Child Abuse Negl 145:106283. 10.1016/j.chiabu.2023.106283
10. Moresi JM, Herbert CR, Cohen BA (2001) Treatment of anogenital warts in children with topical 0.05% podofilox gel and 5% imiquimod cream. Pediatr Dermatol 18:448–450. 10.1046/j.1525-1470.2001.1980a.x
11. Boyer M, Boyer M, Joly E, Diallo K, Hantz S, Fouéré S et al (2026) 2024 recommendations for the therapeutic management of anogenital warts. Ann Dermatol Venereol 153:103510. 10.1016/j.annder.2026.103510
12. Gilson R, Nugent D, Werner RN, Ballesteros J, Ross J (2019) IUSTI-Europe guideline for the management of anogenital warts. J Eur Acad Dermatol Venereol. 2020;34:1644–53. 10.1111/jdv.16522

Figures



One child received both imiquimod and cryotherapy as first-line therapy.

Figure 1

Therapeutic management of anogenital warts according to treatment line.
Number of children receiving each treatment as first-, second-, third-, or fourth-line therapy. The total number of treatments administered at each treatment line is indicated.