Article published online: 2024-01-04

Trends in Gender-Affirming Surgeries in the United States from 2010 to 2021

Ally Ha[1] Kassra Garoosi[2] Elijah Hale[2] Ty Higuchi[3] Julian Winocour[1] David W. Mathes[1] Christodoulos Kaoutzanis[1]

[1] Department of Surgery, Division of Plastic and Reconstructive Surgery, Anschutz Medical Campus, Aurora, Colorado
[2] University of Colorado School of Medicine, Aurora, Colorado
[3] Department of Surgery, Division of Urology, Anschutz Medical Campus, Aurora, Colorado

Address for correspondence Christodoulos Kaoutzanis, MD, University of Colorado Anschutz Medical Campus, Department of Surgery, Division of Plastics and Reconstructive Surgery, (e-mail: ckaoutzanis@gmail.com).

Indian J Plast Surg 2024;57:47–53.

Abstract

Introduction: In 2017, an estimated 1.6 million adults and 150,000 teenagers identified as transgender in the United States. With ever-changing legislative developments regarding health care benefits for this population and the increasing number of patients presenting for gender-affirming surgery (GAS), there is a scarcity of literature on the temporal trends within the past decade. The objective of this study was to examine the temporal trends of the utilization of GAS.

Methods: We conducted a cross-sectional study using TriNetX, a federated research network containing deidentified aggregate patient data. Using International Code of Disease (ICD) and Current Procedural Terminology (CPT) codes, we identified patients with a diagnosis of gender dysphoria who underwent GAS from 2010 to 2021. Basic demographic information and complications were analyzed. Complications of interest included site failure, infection, and systemic complications.

Results: We identified a total of 8,403 patients who underwent GAS between January 2010 and December 2021. The number of procedures per year increased nearly 500% between 2016 and 2021 from 421 procedures to 2,224 procedures. Our demographic results were consistent with previous survey-based studies. The average age of patients who underwent masculinizing surgeries was consistently younger than those who underwent feminizing surgeries. Most patients undergoing GAS were of white race. The overall complication rate was 4.7%.

Conclusion: In conclusion, our study reveals a significant and rapid rise in the utilization of GAS in the United States, with a fivefold increase in procedures between 2016 and 2021. The demographic characteristics and low complication rates observed highlight the evolving landscape of health care for transgender individuals and the need for ongoing assessment and support in this field.

Keywords

- gender-affirming surgery
- gender reassignment surgery
- surgical outcomes
- transgender surgery
- TriNetX

article published online
January 4, 2024

DOI https://doi.org/10.1055/s-0043-1778096.
ISSN 0970-0358.

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Introduction

Gender dysphoria affects an estimated 25 million individuals worldwide or 0.5% of the global population.[1] In 2017, there were approximately 1.4 to 1.6 million transgender adults and 150,000 transgender teens in the United States.[2] Gender dysphoria has been associated with a high burden of adverse health outcomes including mental health distress, substance abuse, violence, and victimization.[3] Relative to the general population, this population has a high prevalence of mental health comorbidities, such as depression, anxiety, suicidal ideation, and suicidal attempts.[4–6]

To address the discordance of their identity, patients may seek gender-affirming interventions to achieve concordance between self-identified gender, physical appearance, and function.[7–9] Gender-affirming interventions include hormone therapy and gender-affirming surgeries (GAS). GAS refers to a diverse group of procedures that change the body to affirm one's gender identity, such as facial reconstruction, breast surgery, or genital reconstruction. Some studies have estimated that only 20 to 40% of transgender individuals seek GAS; however, these estimates are based on surveys of convenience samples of transgender individuals, which limit their generalizability.[6,10]

Greater public attention and awareness of gender diversity and inclusion have expanded treatment options and insurance coverage of GAS over the last decade. The Patient Protection and Affordable Care Act and its associated section 1557 was passed by the Congress in March 2010 and prohibited insurance companies from using categorical exclusion policies for health services, including those for the transgender population.[11] In July 2012, the U.S. Department of Health and Human Services banned marketplace plans from discriminating based on gender identity.[12] Currently, 21 states in the United States and the District of Columbia protect transgender health care in state Medicaid services and/or have placed bans on insurance exclusions for transgender health care.[13–16] Routine care and hormone therapy are covered by Medicare and the Veterans Health Administration.[12] These interventions have gained attention from third-party payers because health insurance coverage for transgender individuals has been shown to be cost-effective, and have an acceptable safety profile.[17,18] Consequently, private insurers have also been expanding coverage to include gender-affirming care.[19] While there have been expansions and protections of transgender care, it is worth mentioning the recent legislative efforts to remove these protections, most notably the *Franciscan Alliance*, which limited gender identity provisions.[20,21]

Despite the ever-changing legislation and insurance coverage in gender-affirming interventions, there is a paucity of information regarding the recent trends in GAS. The goal of this study was to examine the temporal trends of GAS, as well as the demographics of those patients undergoing GAS, from 2010 to 2021 in the United States using the TriNetX database.

Methods

Data Source

The TriNetX Research Network database (Cambridge, MA) is a global health-collaborative clinical research platform collecting real-time electronic medical data from more than 250 million patients, 120 health care organizations, and 19 countries.[22] TriNetX is certified to the ISO 27001:2013 standard and maintains an Information Security Management System (ISMS) to ensure the protection of the health care data it has access to and to meet the requirements of the HIPAA (Health Insurance Portability and Accountability Act of 1996) Security Rule. Any data displayed on the TriNetX Platform in aggregate form, or any patient level data provided in a data set generated by the TriNetX Platform, only contain de-identified data as per the de-identification standard defined in Section §164.514(a) of the HIPAA Privacy Rule. Because this database is free of all personal health information, institutional review board approval was not needed to conduct this study.

Patient Selection/Design

This study was conducted as a retrospective cohort review of the TriNetX database. We queried the database for patients with the International Code of Disease, 10th Edition (ICD-10) diagnosis code for transsexualism (ICD-10: F64.0), gender identity disorder (ICD-10: F64.1, F64.2, F64.8, F64.9), or personal history of sex reassignment (ICD-10: Z87.890) at the time of surgery between 2010 and 2021. To identify patients within this dataset who underwent GAS, patients with Current Procedural Terminology (CPT) and ICD-10 procedure codes associated with feminizing or masculinizing procedures, defined by the Centers for Medicare and Medicaid Services (CMS) and the American Society of Plastic Surgeons, were pulled.[23,24] The data were further subdivided into male-to-female (MtF) top surgeries, male-to-female (MtF) bottom surgeries, female-to-male (FtM) top surgeries, and female-to-male (FtM) bottom surgeries.

Patient information collected included age at index procedure, gender, race, ethnicity, procedure type, and complications within 90 days of the index procedure. Complications were defined by available ICD-10 codes, which included site failure, infection, and systemic complications. Only patients who were 18 years or older were included in our analysis. Facial reconstruction for GAS was not included in our dataset.

Results

Patient Demographics

A total of 8,403 transgender patients who underwent a GAS between January 2010 and December 2021 were identified in the TriNetX database. Most patients were white, even when accounting for those whose race or ethnicity were unknown in the database (►**Table 1**). The average age of patients who underwent a masculinizing surgery was consistently younger than those who underwent a feminizing surgery (►**Fig. 1**).

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Table 1 Baseline demographics of patients who underwent GAS from 2010 to 2021

Feminizing surgery (MtF)	**2010–2015 (*N* = 118)**	**2016 (*N* = 106)**	**2017 (*N* = 183)**	**2018 (*N* = 332)**	**2019 (*N* = 562)**	**2020 (*N* = 531)**	**2021 (*N* = 736)**
Age (y) ± SD	36.7 ± 15	41.8 ± 15	37.9 ± 15	38.2 ± 14	37.4 ± 14	37.6 ± 14	36.2 ± 13
White, *n* (%)	84 (71.19%)	75 (70.75%)	134 (73.22%)	248 (74.7%)	434 (77.22%)	423 (79.96%)	574 (77.99%)
Black, *n* (%)	13 (11.02%)	14 (13.21%)	27 (14.75%)	30 (9.04%)	39 (6.94%)	30 (5.65%)	40 (5.43%)
Hispanic/Latino, *n* (%)	15 (12.71%)	10 (9.43%)	10 (5.46%)	36 (10.63%)	30 (5.34%)	33 (6.21%)	49 (6.66%)
Not Hispanic or Latino, *n* (%)	95 (80.51%)	92 (86.79%)	154 (84.15%)	275 (82.83%)	478 (85.05%)	451 (84.93%)	623 (84.65%)
Unknown ethnicity, *n* (%)	10 (8.46%)	10 (9.43%)	20 (10.93%)	21 (6.33%)	54 (9.61%)	47 (8.85%)	64 (8.7%)
Unknown race, *n* (%)	18 (15.25%)	15 (14.15%)	17 (9.29%)	39 (11.75%)	64 (11.39%)	58 (10.92%)	90 (12.23%)
Masculinizing Surgery (FtM)	**2010–2015 (*N* = 721)**	**2016 (*N* = 315)**	**2017 (*N* = 448)**	**2018 (*N* = 674)**	**2019 (*N* = 1,044)**	**2020 (*N* = 1,145)**	**2021 (*N* = 1,488)**
Age (y) ± SD	26.9 ± 9	27.9 ± 10	28.1 ± 10	27.0 ± 10	26.4 ± 10	26.7 ± 10	27.0 ± 9
White, *n* (%)	355 (49.24%)	161 (51.11%)	337 (75.22%)	577 (85.61%)	727 (69.64%)	794 (69.34%)	1088 (73.12%)
Black, *n* (%)	35 (4.85%)	28 (8.89%)	47 (10.49%)	53 (7.86%)	87 (8.33%)	104 (9.08%)	111 (7.46%)
Hispanic/Latino, *n* (%)	15 (2.08%)	15 (4.76%)	35 (7.81%)	90 (13.35%)	79 (7.57%)	66 (5.76%)	107 (7.19%)
Not Hispanic or Latino, *n* (%)	389 (53.95%)	198 (62.86%)	366 (81.7%)	556 (82.49%)	727 (69.64%)	794 (69.64%)	1088 (73.12%)
Unknown ethnicity, *n* (%)	317 (43.97%)	102 (32.38%)	47 (10.49%)	125 (18.55%)	249 (23.85%)	286 (24.98%)	294 (19.74%)
Unknown race, *n* (%)	319 (44.24%)	118 (37.46%)	59 (13.17%)	92 (13.65%)	198 (18.97%)	198 (17.29%)	252 (16.94%)

Abbreviations: FtM, female to male; GAS, gender-affirming surgery; MtF, male to female.

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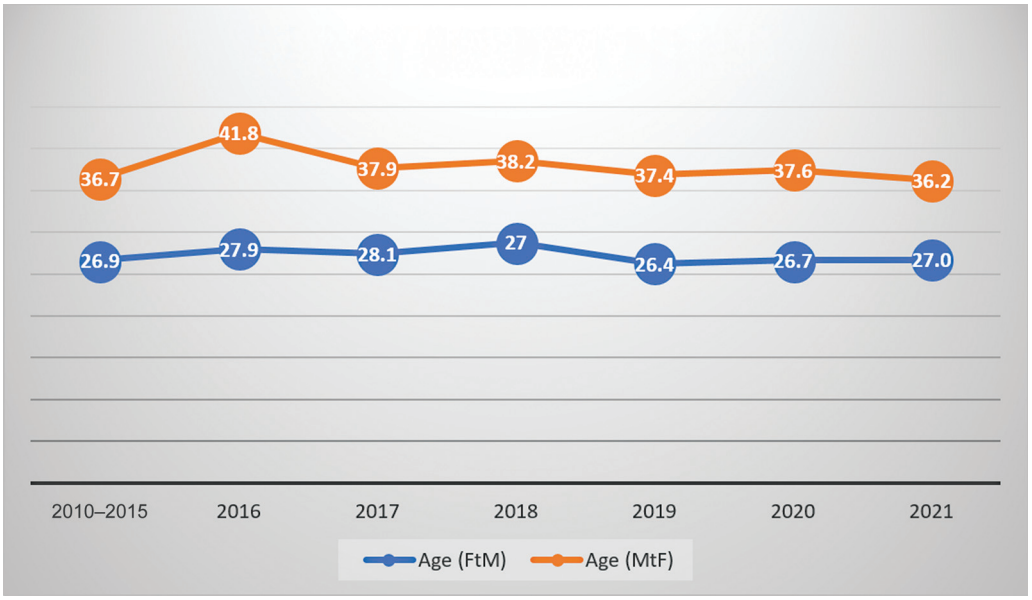

Fig. 1 Average age of patients who underwent a masculinizing or feminizing GAS. FtM, female to male; GAS, gender-affirming surgery; MtF, male to female.

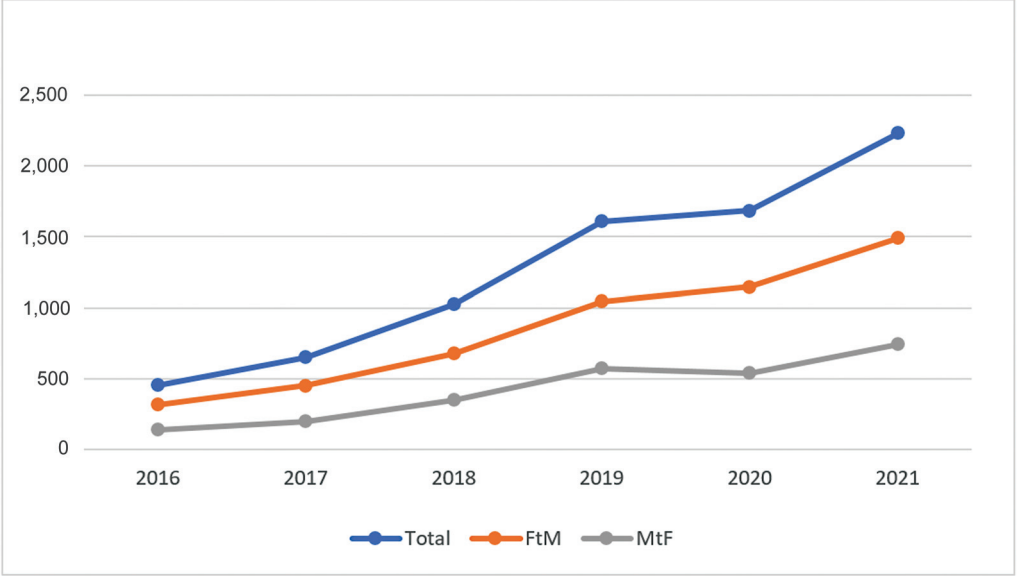

Fig. 2 Number of gender-affirming surgery (GAS) per year from 2016 to 2021.

Temporal Trends

The overall number of procedures increased nearly fivefold between 2016 ($N = 421$) and 2021 ($N = 2,224$; ►**Fig. 2**). Masculinizing procedures ($N = 5,835$ cases) were more than twice as common as feminizing procedures ($N = 2,568$), a trend that is consistent throughout the study period. Within the same time period, the number of feminizing procedures increased nearly sevenfold from 106 cases to 736 cases, while the number of masculinizing procedures increased over fourfold from 315 cases to 1,488 cases (►**Fig. 2**). Mastectomy was the most commonly performed GAS within the study period, accounting for at least a third of all masculinizing procedures every single year and 52.4% ($N = 4,400$) of all procedures in the sample. Phalloplasty was the least common procedure, accounting for only 8.4% ($N = 705$) of all GAS cases during the study period (►**Fig. 3**).

Complications

In total, there were 397 (4.7%) complications, with the most common being noninfectious site failure. The complication rate increased from 2016 to 2018, then decreased through 2020 before increasing in 2021 (►**Table 2**).

Discussion

The purpose of this study was to report on the demographics of the transgender population in the United States undergoing a GAS and the trends in GAS over the past decade. The

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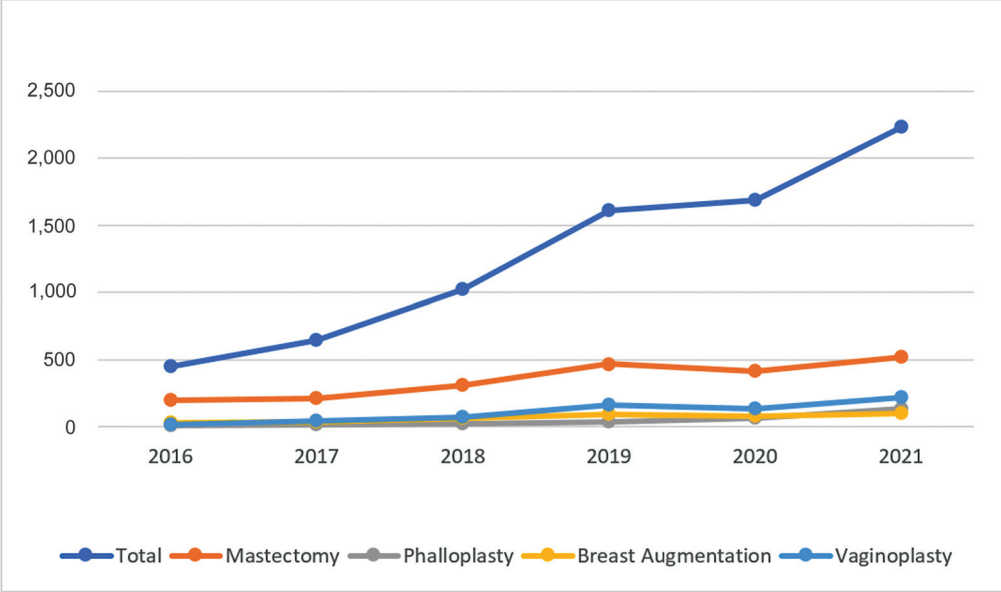

Fig. 3 Procedure-specific gender-affirming surgery (GAS) per year from 2016 to 2021.

Table 2 Complications by year

Complications ($N = 8,403$)	2010–2015 ($n = 839$)	2016 ($n = 421$)	2017 ($n = 631$)	2018 ($n = 1,006$)	2019 ($n = 1,606$)	2020 ($n = 1,676$)	2021 ($n = 2,224$)
Any complication, *n* (%)	18 (2.15%)	10 (2.38%)	30 (4.75%)	50 (4.97%)	86 (5.35%)	84 (5.01%)	119 (5.34%)
Site failure (noninfectious), *n* (%)	11 (1.31%)	10 (2.38%)	21 (3.33%)	34 (3.38%)	61 (3.80%)	56 (3.34%)	88 (3.96%)
Infections, *n* (%)	12 (1.43%)	10 (2.38%)	10 (1.58%)	10 (0.99%)	19 (1.18%)	13 (0.78%)	24 (1.08%)
Systemic, *n* (%)	10 (1.19%)	10 (2.38%)	12 (1.90%)	16 (1.59%)	15 (0.93%)	23 (1.37%)	22 (0.99%

patient population in this study were similar in age and racial demographics with previous studies, including the lower average age of FtM patients when compared to MtF patients.[18,19] The increasing number of GAS in the past decade shown in this study is consistent with the upward trend shown in previous studies analyzing trends in the 2000s.[25] Furthermore, the higher rates of masculinizing procedures, with the most common procedure being mastectomy, remain a consistent trend across the years as the overall number of GAS increases.[18,26–28] The 4.7% total complication rate in this study's patient population who underwent a GAS between 2010 and 2021 is lower than similar studies completed in the earlier decade.[18,29]

This study demonstrates the consistent increase of patients in the United States undergoing GAS over the past decade at a higher rate than in the previous decade. This can be attributed to a number of reasons, such as increased societal acceptance of gender diversity, legislative changes that increased access to care such as the passing of the Patient Protection and Affordable Care Act in 2010, and more formalized institutional education and training that increased the number of qualified surgeons with specific surgical skills in gender affirmation care. The upward trend of case volume was most modest from 2019 to 2020, most likely due to the drop in elective surgical cases at the beginning of the COVID-19 pandemic. The direct association between access to care and GAS rates has been shown in previous studies analyzing transgender patients before 2010. These demonstrated that the majority of those who underwent a GAS were of higher economic status and were either self-pay or with private health maintenance organization (HMO).[5,6] A study utilizing the National Inpatient Sample demonstrated that persons seeking GAS with Medicare or Medicaid coverage increased by threefold from 2012 to 2014.[25] The Centers for Medicare & Medicaid Services began covering transition-related services for patients in 2014 through implementation of the Affordable Care Act, which may help explain the increase of GAS among Medicare patients.[30] Finally, the increased case volume, and thus experience, over the past decade may also explain the decrease in overall complication rate seen in this study, when compared to similar previous studies. To the best of our knowledge, there are currently five advanced surgical fellowships specializing in GAS in the United States, all of which were only formalized recently.

Although increasing in incidence, genital reconstruction surgeries remain uncommon due to various reasons. Transgender men are more likely than transgender women to

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undergo GAS and are more likely to seek "top" surgery because it is more readily apparent and more accessible because of an increased surgeon familiarity with the procedure. On the other hand, genital reconstructions are less common as they typically require multiple stages and a multidisciplinary approach, are more invasive, have the least visible results, and are associated with higher complication rates.[31–35] This is more evident for masculinizing genital reconstructions. Complication rates have been reported to be as high as 32 to 54% for phalloplasty and 4 to 25% for vaginoplasty.[31–36] As the number of genital reconstruction procedures increase, they may have a disproportionately larger effect on complication rates as they become more commonly performed.

This study is the first use of a large comprehensive database to examine this patient population undergoing GAS in the last decade since the passing of the Patient Protection and Affordable Care Act in 2010. The increasing number of transgender patients undergoing GAS demonstrated in this study suggests that this population's access to care, and subsequently, surgical outcomes, has been significantly influenced by social and political shifts in the past decade. This study is intended to be a first step in monitoring the trends of GAS in the United States as legislative changes are executed, which directly determine this population's access to care.

Limitations

This study is not without limitations. The reliance on electronic medical data from the TriNetX Research Network database may introduce several limitations. The TriNetX database is reliant upon accurate coding, which creates the potential for a reporting bias. As with all large database studies, this data analysis was dependent on the availability of variables, vigorousness of variable definition, and accuracy of data coding and entry. ICD-9 conversion to ICD-10 started in 2009 with mandatory compliance by 2014, and the TriNetX database includes the converted ICD-9 procedural codes, which creates the potential for missed cases due to inaccurate conversions. Moreover, the use of coded diagnoses and procedure data may not capture the full spectrum of transgender and gender-diverse individuals, as these codes depend on accurate documentation by health care providers. Misclassification or underreporting of gender dysphoria-related diagnoses and GAS procedures could affect the accuracy of the results.

In addition to potential coding errors, the overall complication rate may have been underreported because some complications (i.e., urethrocutaneous fistulas or persistent vaginal remnants) do not have specific ICD-10 codes and, thus, are not documented in the TriNetX database.

Similarly, due to database and sample size constraints, TriNetX was not able to parse out specific causes of the limitations, which resulted in complication groupings (i.e., any complication, site failure [noninfectious], infections, and systemic). Of note, the database does not differentiate between minor complications that can be treated with outpatient management versus major complications, such as those requiring reoperation. A more detailed analysis of complications and their impact on patient outcomes would enhance the understanding of the risks associated with GAS.

Potential underreporting may also exist within the presented case numbers. Not all gender-affirming procedures, such as facial reconstruction for gender affirmation, were included in our study due to their cosmetic classification and thus lack of consistent representation in the TriNetX database. Likewise, our analysis was restricted to patients who were 18 years or older. This exclusion of minors undergoing gender-affirming procedures may not provide a comprehensive view of all individuals seeking these interventions. These potential underreporting may have affected the data from 2010 to 2015, which were grouped together in this due to low case numbers. Finally, the retrospective cohort study design prevents the ability to perform multivariate or regression analyses.

Conclusion

In conclusion, this study provides an analysis of the demographics and trends in GAS in the United States from 2010 to 2021, shedding light on the evolving landscape of transgender health care. The consistent increase in the number of patients seeking GAS over the past decade reflects the growing societal acceptance of gender diversity, the influence of legislative changes like the Patient Protection and Affordable Care Act, and the expansion of formalized education and training for surgeons in gender-affirming care. The lower complication rate observed in this study compared to studies from earlier decades suggests improved surgical outcomes and increased experience among health care providers. Furthermore, this study represents a significant step in monitoring the changing landscape of GAS in the United States, as it reflects the dynamic interplay between social, political, and health care factors influencing this patient population's access to care. Future research should aim to address the presented limitations and provide a more in-depth analysis of complications and patient outcomes to further enhance our understanding of the risks and benefits associated with GAS.

Conflict of Interest
None declared.

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