

## Analysis between open and laparoscopic appendectomy. A comparative study of the procedure in Brazil and worldwide

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**Ana Carolina C. Cruz<sup>1</sup>, Manoel Alves do N. Filho<sup>2</sup>, Beatriz Oliveira Spina<sup>3</sup>, Juliana Fontes B. Paschoal<sup>4</sup>, Délio Tiago M. Malaquias<sup>5</sup>, Diógenes Trabuco da Silva Oliveira<sup>6</sup>, Letícia Silveira Arut<sup>7</sup>, Aline Cristina Couto da Silva<sup>8</sup>, Anna Luiza Staianov Mitani<sup>9</sup>, Thayane Gonçalves da S. Marques<sup>10</sup>, Bruna Daniel Araujo<sup>11</sup>, Cindy Alves Vilarinho<sup>12</sup>, Mariana Machado Regonha<sup>13</sup>, Lucas Vieira<sup>14</sup>, Ana Clara F. Parreira<sup>15</sup>, Cristiana do Nascimento O. Beloto<sup>16</sup>, Hannah Kamarowski Fontana<sup>17</sup>, Jade P. Torres Gualter<sup>18</sup>, Rafaela Ribeiro Benedito<sup>19</sup>, Aline Cristina Couto da Silva<sup>20</sup>, Giovana de Souza Campos<sup>21</sup>, Filipe Jabur Lot Garcia<sup>22</sup>, Giovana Rocha Victorello<sup>23</sup>, Isabelle Pinheiro Santos<sup>24</sup>, Lucimara Pigaiani<sup>25</sup>, Hamilton Roberto Moreira de Oliveira Carriço<sup>26</sup>, Rafaela Queiroz Sabbag<sup>27</sup>, Liliana Martins Occulate<sup>28</sup>, Cristiano Bento Alvarenga<sup>29</sup>, Vinicius Augusto Trento Galloro<sup>30</sup>, Lucas do Vale Barreto<sup>31</sup>, Igor Garcia Sanches de Souza<sup>32</sup>, Giovana Casarini Yamashiro<sup>33</sup>, Josmar Ramon Krüger Klock<sup>34</sup>, Gabriela Rodrigues da Mota<sup>35</sup> and Thiago Augusto R. Bezerra<sup>36</sup>**

<sup>1</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>2</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>3</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>4</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

PhD in Biotechnology. University of São Paulo. São Paulo, Brazil.

<sup>5</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>6</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>7</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>8</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>9</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>10</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>11</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>12</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>13</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>14</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>15</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>16</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>17</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>18</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>19</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>20</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>21</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>22</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>23</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>24</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>25</sup> Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.

<sup>26</sup> Medical student. University of Southern Santa Catarina. Tubarão, Santa Catarina, Brazil.

<sup>27</sup> Medical student. São Leopoldo Mandic. Campinas, São Paulo, Brazil.

<sup>28</sup> Medical student. Central University of Paraguay. Ciudad del Lest. Paraguay.

<sup>29</sup> Medical student. Central University of Paraguay. Ciudad del Lest. Paraguay.

<sup>30</sup> Graduated in Medicine. Albert Einstein Israeli College of Health Sciences. São Paulo, Brazil.

<sup>31</sup> Graduated in Medicine. Albert Einstein Israeli College of Health Sciences. São Paulo, Brazil.

<sup>32</sup> Graduated in Medicine. Albert Einstein Israeli College of Health Sciences. São Paulo, Brazil.

<sup>33</sup> Medical student. Nove de Julho University. São Bernardo do Campo, São Paulo, Brazil.

<sup>34</sup> Graduated in Medicine. University of the Southern Border. Passo Fundo, Rio Grande do Sul, Brazil.

<sup>35</sup> Graduated in Medicine. Federal University of the Southern Border. Passo Fundo, Rio Grande do Sul, Brazil.



## ABSTRACT

**Introduction:** The appendix is an organ in the human body that serves as a reservoir for natural bacteria in the gastrointestinal tract and also has an immunological function that is not so well understood. The acute inflammatory process that can occur in this organ is called acute appendicitis and is the most common surgical emergency worldwide. **Objectives:** To carry out a literature review on the analysis between open and laparoscopic appendectomy, and to compare how this surgery is performed in Brazil and worldwide. **Material and Methods:** The methodology used was a literature review. The research was carried out through an electronic search of scientific articles published on the Scielo (Scientific Electronic Library Online) and Lilacs (Latin American Health Sciences Literature) and Pubmed websites. The health terminologies consulted in the Health Sciences Descriptors (DeCS/BIREME) were used to analyze open and laparoscopic appendectomy. **Discussion:** Appendectomy has largely replaced open surgery as the treatment of choice for diseases of the appendix, especially acute inflammation, as it has effective results and some advantages. Video appendectomy did not gain absolute acceptance as quickly as cholecystectomy, for example, and it is only in the last 10 years that this type of minimally invasive approach has excelled the open approach worldwide. **Conclusion:** According to the literature, laparoscopy has recently become the most prevalent way of performing appendectomy. Despite this trend, the majority of appendectomies were performed by the open route. This can be explained by logistical, financial or medical team preparation issues. Some studies have shown that the rate of complications after surgery in the laparoscopic group was significantly lower than in the open appendectomy group.

**Keywords:** Appendicitis, Acute, Appendectomies, Laparoscopy.

## INTRODUCTION

Appendectomy is one of the most commonly performed surgeries in the world, as it occurs mainly due to acute appendicitis. As it is a very prevalent surgical emergency, it is necessary to analyze the epidemiological data such as hospitalizations, costs, mortality and average hospital stay of the ways in which it is performed: open or laparoscopic (ANDRADE, et al, 2023).

In the last 10 years, the new world standard has made laparoscopy the treatment of choice, but Brazil has yet to follow this reality due to the precariousness of the infrastructure and training of surgeons. In addition, as this modality is less invasive, it reduces complications and hospital stays, despite having higher costs (DE PAULA SOUZA et al. 2023).

In Brazil in 2023, the total number of appendectomies was 684,278, with an average of 97,754 per year. Of this total, 2% were laparoscopic, which represents 13,801 surgeries in absolute terms (ANDRADE, et al, 2023).

According to Dos Santos et al. (2020), emergency surgery for the treatment of acute appendicitis differs from elective surgery. Therefore, due to the benefits it brings, we should seek to expand the use of laparoscopy to remove the appendix in order to provide the best for patients.

The appendix is an organ in the human body that serves as a reservoir for natural bacteria in the gastrointestinal tract and also has an immunological function that is not yet well understood (FERREIRA, et al. 2020).

The acute inflammatory process that can occur in this organ is called acute appendicitis and is the most common surgical emergency worldwide (KUMAIRA, et al. 2021).

The most common cause of this pathology is obstruction of the appendix lumen, whether by fecalith, organic material, solid substances or even tumors. In addition, genetic, environmental and ethnic factors have been found to explain the involvement of this disease in some people (FONSECA et al. 2021).

According to Long et al. (2021), this type of acute inflammatory abdomen is the main indication for removal of the appendix (appendectomy), since even appendicular tumors, which are extremely rare, present with acute appendicitis and end up being diagnosed by histopathological examination of the surgical specimen.

The most frequent local complications reported in the literature are wall abscesses, residual abscesses, intestinal obstruction, fecal fistula, evisceration, eventration, peritonitis and hemorrhage (FONSECA et al. 2021).

The classic signs and symptoms of this disease can be defined as abdominal pain starting in the hypogastrium and migrating to the right iliac fossa, anorexia, fever, leukocytosis and other



laboratory signs of inflammation and can be present in more than 60% of cases. In addition, imaging tests such as total abdominal ultrasound and tomography (MARCELLO, 2021).

## **OBJECTIVES**

To carry out a literature review on the analysis between open and laparoscopic appendectomy, and to compare how this surgery is performed in Brazil and worldwide.

## **MATERIAL AND METHODS**

The methodology used was a literature review. The research was carried out by means of an electronic search for scientific articles published on the Scielo (Scientific Electronic Library Online) and Lilacs (Latin American Health Sciences Literature) and Pubmed websites. The health terminologies consulted in the Health Sciences descriptors (DeCS/BIREME) were used; on the analysis between open and laparoscopic appendectomy.

The inclusion criteria were: original article, published in Portuguese and English, freely accessible, in full, on the subject, in electronic format and published, totaling 20 articles.

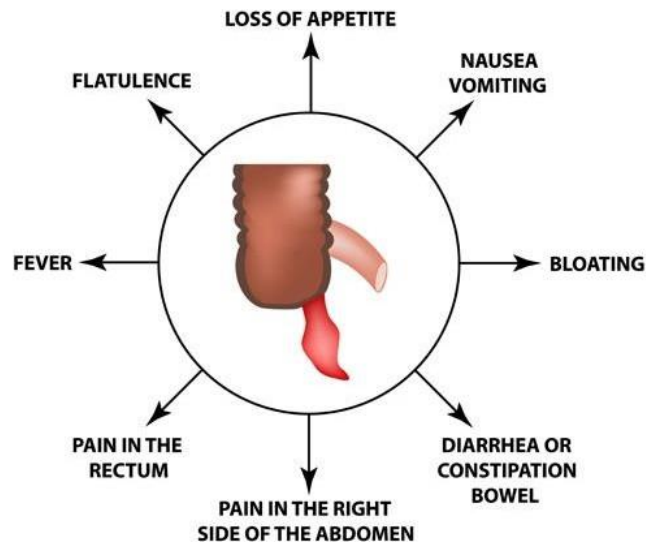
## **DISCUSSION**

Acute appendicitis can present clinically in a non-specific way with overlapping symptoms with other common childhood illnesses, as well as evolving with periumbilical abdominal pain migrating to the right lower quadrant, followed by low-grade fever, nausea or vomiting (KURTZ, 2001).

Appendectomy is a surgical procedure designed to remove the vermicular appendix, a small tubular structure that is a small extension of the caecum, the initial portion of the large intestine. The most common symptoms can be seen in FIGURE 1.

Figure 1. Most common symptoms of appendicitis. Source: researchgate.net appendectomy Symptoms.

### SYMPTOMS OF APPENDECTOMY



Acute appendicitis is the most common cause of acute abdomen in the Western world and, as a consequence, appendectomy is one of the most commonly performed surgical procedures (KURTZ, 2001).

According to Ferreira et al. (2020), surgical indications refer to the specific conditions or situations that justify performing a medical procedure, while the purpose describes the main objectives of this procedure.

In the case of an appendectomy, the indications and purpose are as follows; appendicitis: the most common indication for an appendectomy is appendicitis, which is inflammation of the appendix. Appendicitis usually presents with symptoms such as abdominal pain, vomiting, nausea, fever and loss of appetite. If left untreated, an inflamed appendix can lead to serious complications, including rupture and peritonitis (NASCIMENTO, et al. 2023).

The main aim of an appendectomy is to treat appendicitis. By surgically removing the inflamed or infected appendix, the source of the inflammation is eliminated, preventing further complications. This helps relieve the patient's symptoms and reduces the risk of potentially life-threatening conditions such as peritonitis (NAVARINI, et al. 2009).

Fonseca et al. (2021), removal of the appendix avoids the possibility of appendix rupture, which can lead to the release of infectious material into the abdominal cavity.

A ruptured appendix can result in peritonitis, a serious infection of the abdominal lining. Removing the inflamed appendix before it ruptures helps to avoid this dangerous situation.

Appendicitis often causes significant pain and discomfort. By removing the source of

inflammation, surgery aims to relieve the patient's symptoms and improve their general well-being (DOS SANTOS, et al. 2020).

In some cases, individuals with a history of recurrent or chronic abdominal pain that may be suggestive of appendicitis may undergo a prophylactic or preventative appendectomy to avoid future episodes of acute appendicitis. It is important to note that appendectomy is a well-established surgical procedure with clear indications for its use. Timely intervention is crucial to avoid complications associated with appendicitis. If you suspect you have appendicitis or have been advised to undergo an appendectomy, it is essential to consult a healthcare professional so that they can advise you on the appropriate course of action based on your individual clinical situation (NAZIR, et al. 2019).

TABLE 1 shows according to NAZIR et al (2019) the typical possible complications of appendectomy in % of their studies.

TABLE 1. Appendectomy complications.

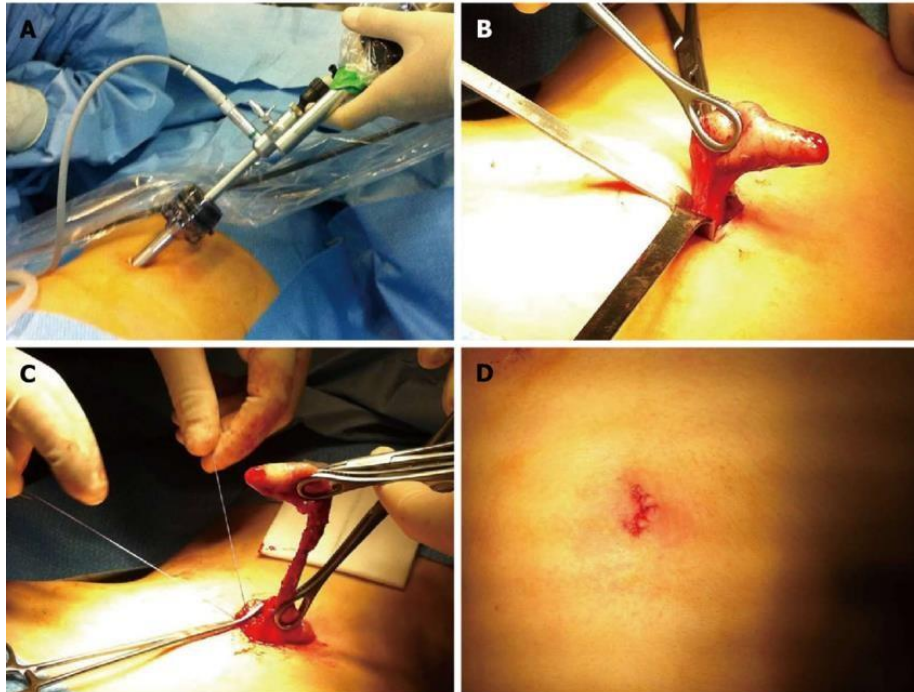
Complications	Frequency	%
Wall abscess	9	2.2
Intraabdominal abscess	9	2.2
Wall hematoma	3	0.8
Intraabdominal hematoma	6	1.5
Prolonged postoperative ileus	9	2.2
Postoperative fever	7	1.8
Urine infection	6	1.5
Intestinal obstruction	2	0.5
Intestinal perforation	1	0.2
Pulmonary thromboembolism	1	0.2
Total	53	13.1

Complications of laparoscopic appendectomy

Source: NAZIR et al (2019).

Currently, in developed countries, video-assisted surgery is the most widely used procedure due to its better post-operative results, despite the higher costs of instruments and operating time (FIGURE 2).

FIGURE 2. Surgical steps for video-assisted transumbilical appendectomy. A: umbilical access for 10 mm port and operating chamber; B: the (phlegmonous) appendix is exteriorized through the umbilicus; C: “classic” open appendectomy; D: skin closure: the umbilicus is closed with 4/0 absorbable quick stitches. Source: [researchgate.net/figure/surgical-steps-for-video-assisted-transumbilical-appendectomy-A-umbilical-access-for-10\\_fig1\\_261765783](https://researchgate.net/figure/surgical-steps-for-video-assisted-transumbilical-appendectomy-A-umbilical-access-for-10_fig1_261765783).



Brazil, which still has a shortage of surgeons and little investment in public hospital networks, is not yet following this global trend. Therefore, there is a need for greater financial incentives and to strengthen the teaching of surgical residents through simulators, so that the best approach is offered to all patients who need this surgery (BASTOS, et al. 2021).

Appendectomy is a safe surgery, with mortality rates of less than 0.7% for both techniques, corroborating the results found. Despite this, studies show that laparoscopic surgery is superior to the open technique as it reduces the rates of post-operative complications such as wound infections and pain (DAI, 2017).

For Bastos et al. (2021), the length of hospital stay and resumption of normal activities compared to the open technique, as can also be seen in the results of other studies.

However, according to Ferreira et al. (2020), open surgery is slightly more expensive than laparoscopic surgery. This diverges from the literature, since the costs of video instrumentation and the longer surgical time tend to increase the cost of performing this surgery.

According to Fonseca et al. (2021), the complication rate of open surgery in underdeveloped countries can reach 48%, which would result in higher costs, explaining the discrepancy found in the results.

The studies by Navarini et al. (2009) show that appendectomy has now largely replaced open surgery as the treatment of choice for diseases of the appendix, especially acute inflammation, as it has effective results and some advantages.

On the other hand, Bastos et al. (2021), cites that video appendectomy was not able to gain absolute acceptance quickly, like cholecystectomy for example, and only in the last 10 years has this type of minimally invasive approach excelled over the open approach worldwide.

However, in Brazil this pattern has not been observed in recent years, since according to the results 94.4% of surgeries to remove the appendix were performed by the open route. This can be explained by the precariousness of financial investment in public health and, above all, investment in the training of former and future surgeons, who need a high volume of patients and technological resources to obtain a technique refined enough to prefer the video approach (MARCELLO, 2021).

Regarding the post-operative period, Bastos et al. (2021) point out that most studies have reported a greater number of complications in patients undergoing conventional appendectomy. One study showed that 30% of patients who underwent open surgery suffered post-operative complications, while only 5% of patients who underwent laparoscopic surgery had complications after surgery. The use of antibiotic therapy in the first 24 hours was also analyzed, as 98% of patients used it in the open procedure and 48% in the laparoscopic procedure. Withdrawal of venous hydration took more than 12 hours in conventional surgery, while in laparoscopic surgery it was carried out in 100% before 12 hours.

The rate of patients with postoperative complications was 5% with laparoscopic surgery and 30% with open surgery (VICENTE, et al. 2017).

For Dai et al. (2017), laparoscopy showed a 60% reduction in mortality compared to open surgery. According to the author, acute appendicitis is one of the most prevalent surgical emergencies in the world, with developed countries having a prevalence rate of 0.1% per year. It is also known that inflammation occurs more quickly in the appendix of younger patients. The average age found in the cohort studied was 8 years old, 52.38% of whom were female, with boys usually being more affected than girls, at a ratio of 1.4:110.

Long et al. (2021) also showed a prevalence of males (52.6%), (n=216) boys, in a total of 389 patients undergoing appendectomy.

There was no statistical difference between the two techniques in terms of the time between the patient's hospitalization and the start of surgery. This average waiting time of around 5 hours (300 minutes), which we consider to be high, may be a reflection of the slow flow of patient care

in the public health service (OHTANI, et al. 2012).

Regarding the costs of both appendectomy methods, taking into account all factors, such as materials used, length of stay, anesthesia, videolaparoscopic appendectomy was 6.6% less expensive than open appendectomy.

Simões and Passos (2021) showed that in a sample of 14,582 hospitalizations for appendectomy, 13,424 were open and 1,158 were laparoscopic. Of this sample, there were 38 deaths of patients undergoing open surgery, and 2 deaths from laparoscopic surgery. In view of the figures, the mortality rate for laparoscopy is 0.17%, while that for the conventional route is 0.28%, totaling a 60% reduction in mortality in appendectomies if performed by the laparoscopic route.

As for the duration of surgery, laparotomy proved to be faster, with an average duration of 92 minutes compared to 151 minutes for laparoscopy, a statistically significant difference (TRONCOSO, 2019).

For Fonseca et al. (2021), laparoscopic appendectomy in pediatric patients had a longer surgical time (51 minutes on average), compared to 37 minutes for the open procedure. As for complicated appendicitis, there was no statistically significant.

There was also no statistically significant difference between the two groups ( $p=0.600$ , Fisher's exact test,  $p<0.05$ ) that could justify a favorable outcome or possible complications based on the surgical technique used.

As for the reintroduction of the oral diet in the post-operative period, there was also no difference between the groups.

According to Long et.al (2021), the majority of patients in both groups received a diet on the 1st post-operative day (75% in the laparoscopic group and 67.4% in the open surgery group).

The systematic review carried out by Andrade et al. (2023) showed 12 studies in which patients who underwent laparoscopy returned to an oral diet in 2.7 days, compared to 3.7 days for the open technique.

Recovery time after appendectomy varies depending on the severity of the infection and also whether the appendix has ruptured. In the event of a ruptured appendix, powerful antibiotics will be administered and the patient will be closely observed for any signs of complication. People are usually advised to avoid driving, drinking alcohol and using machinery for up to 2 days after surgery (FIGURE 3).

Figure 3. Possible complications of appendectomy. Source: OHTANI, 2012.

## Appendectomy- What to Expect

Some possible complications of an appendectomy include:



In the literature, there is evidence that the advantages of laparoscopy include a lower risk of surgical wound infection, a reduction in postoperative pain, a shorter hospital stay and an early return to normal activities (BASTOS, et al. 2021).

Dos Santos et al. (2020) showed an association between laparoscopy and shorter hospital stays, not only for uncomplicated appendicitis but also for complicated appendicitis, which even had lower readmission rates due to post-surgical complications.

According to Simões and Passos (2021), the average length of hospital stay was 3.5 and 4.7 days for laparoscopic and open techniques, respectively. Patients who underwent laparoscopy had lower levels of post-operative pain and an earlier recovery.

In the study by Long et al. (2021), the average length of stay was 3 days in the laparoscopic group compared to 6 days in the open group. In contrast, the results analyzed in our study show that there is no statistically significant difference in the length of hospital stay when comparing the two surgical methods, with a mean time of approximately 3 days in both groups.

## CONCLUSIONS

Laparoscopic appendectomy showed a significant advantage over open appendectomy.

According to the literature, laparoscopy has recently become the most prevalent method of appendectomy

Despite this trend, the majority of appendectomies were performed by the open route. This can be explained by logistical, financial or medical team preparation issues.

Some studies have shown that the rate of complications after surgery in the laparoscopic



group was significantly lower than in the open appendectomy group.

In general, the analysis of the present study allows us to state, within statistical limitations, that there is no difference between open and laparoscopic appendectomy in terms of length of stay, introduction of oral diet and post-operative complications, with only the surgical time being relevant, which was longer in the laparoscopic group.

Early recovery, less need for analgesics, earlier return to daily activities and a better aesthetic result are factors that have a major impact in favor of laparoscopic appendectomy.

This study therefore suggests that the laparoscopic approach has potential for growth in the treatment of acute appendicitis in Brazil, with the possibility of reducing treatment costs.

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