

# **A Break-Even Cost-effectiveness Analysis for Venous Thromboembolism Prophylaxis in Achilles Tendon Repair Surgery**

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**INTRODUCTION:** Venous thromboembolism (VTE) is a potentially life-threatening complication following orthopaedic surgery. While prophylaxis is well-established in joint arthroplasty, its role after Achilles tendon repair remains controversial. Despite being a soft-tissue procedure, prolonged postoperative immobilization increases VTE risk, with some studies reporting symptomatic rates as high as 7%. However, no prior studies have assessed the cost-effectiveness of pharmacologic VTE prophylaxis in this population. This study aims to evaluate the cost-effectiveness of commonly used pharmacologic agents for VTE prophylaxis following primary Achilles tendon repair, including aspirin, enoxaparin, rivaroxaban, and warfarin. Using a break-even analysis model informed by real-world incidence data from a large multicenter database and current drug pricing, we aim to provide an objective framework to evaluate the economic implications of VTE chemoprophylaxis and aid in the decision-making process.

## **METHODS:**

This study utilized a modified cost-effectiveness equation to calculate the break-even venous thromboembolism (VTE) rate required for a prophylactic intervention to be cost-effective (Figure 1). The break-even rate was subtracted from the initial VTE rate to determine the absolute risk reduction (ARR) needed for cost neutrality. The ARR was then used to calculate the number needed to treat (NNT), representing the number of primary Achilles tendon repairs that would need to be performed with prophylaxis to prevent one symptomatic VTE event while remaining cost-effective. A literature review and the TriNetX Research Network were used to identify symptomatic VTE rates within 30 days of primary Achilles tendon repair without pharmacologic prophylaxis. The low, intermediate and high rates of symptomatic VTE were determined to be 0.53%, 0.72% and 7.2%. The cost of treating a symptomatic VTE was estimated to equal \$20,461.32 based on existing literature and adjusted to 2025 U.S. dollars. Retail drug pricing was obtained from an online pharmacy database. The product costs for a 1-month supply of once-daily aspirin (81 mg), aspirin (325 mg), enoxaparin (40 mg), rivaroxaban (20 mg), and warfarin (5 mg) were found to be \$1.94, \$2.00, \$156.00, \$526.22, and \$2.22, respectively. The lowest cost of INR testing was estimated to equal \$6.19, so the total price for warfarin (5mg) plus INR testing was \$8.41.

## **RESULTS:**

Among 8,935 patients undergoing Achilles tendon repair without chemoprophylaxis, 47 developed a symptomatic VTE (0.526%). At the product cost obtained, aspirin 81 mg was found to be cost-effective at the TriNetX, intermediate and high rates of symptomatic VTE if the initial rate decreased by an ARR of 0.01% (NNT=10,547). Aspirin 325 mg was also cost-effective at all 3 initial rates with an ARR 0.01% (NNT = 10,231). Likewise, warfarin (5 mg) was cost-effective at all 3 initial rates with an ARR of 0.01% (NNT = 9,217). Additionally, warfarin remained cost-effective when factoring in the lowest cost of INR monitoring (NNT = 2,433) (Table 1). In contrast, cost-effectiveness was eliminated at the intermediate and TriNetX symptomatic VTE rates for enoxaparin (40 mg) because the final VTE rate exceeded the initial rate. However, cost-effectiveness was achieved for enoxaparin (40 mg) at the high symptomatic VTE rate with an ARR of 0.76% (NNT = 131). Similarly, rivaroxaban (20 mg) was not cost-effective at the intermediate or TriNetX symptomatic VTE rate. Additional analyses demonstrated that enoxaparin (40 mg) and rivaroxaban (20 mg) become cost-effective when costs of treating a symptomatic VTE are higher (Table 2).

**DISCUSSION AND CONCLUSION:** In this study, we found that aspirin 81 mg, aspirin 325mg, and warfarin are cost-effective for VTE chemoprophylaxis following surgery for Achilles tendon rupture. Enoxaparin and rivaroxaban are generally not cost effective. While there is no broad consensus on venous thromboembolic prophylaxis following foot and ankle surgery, most authors agree that VTE rates are relatively higher following Achilles tendon ruptures and that these patients should receive strong consideration for VTE chemoprophylaxis. Nevertheless, these decisions should be made on a patient-specific basis to achieve optimal outcomes. The cost-effectiveness data presented in this study can aid in the decision-making process but does not impute a recommendation for or against the use of a specific VTE chemoprophylactic agent.

Figure 1: Equation for break-even cost-effectiveness analysis

$$S_{total} \times C_i \times VR_f = (S_{total} \times C_d) + (S_{total} \times C_i \times VR_f)$$

Solving for  $VR_f$  yields:

$$VR_f = \frac{(VR_f \times C_i) - C_d}{C_i}$$

Table 1: Cost-effectiveness of Chemoprophylactic Agents at Varying Initial Venous Thromboembolism Rates

Drug	Cost of Drug, \$	Cost of Treating VTE	Initial VTE Rate, %	Final VTE Rate, %	ARR, %	NNT
Aspirin (81mg)	1.94	20,461.32	0.526	0.52	0.01	10,547
	1.94	20,461.32	0.72	0.71	0.01	10,547
	1.94	20,461.32	7.2	7.19	0.01	10,547
Aspirin (325mg)	2.00	20,461.32	0.526	0.52	0.01	10,231
	2.00	20,461.32	0.72	0.71	0.01	10,231
	2.00	20,461.32	7.2	7.19	0.01	10,231
enoxaparin (40 mg)	156.00	20,461.32	0.526	-0.24	0.76	131
	156.00	20,461.32	0.72	-0.04	0.76	131
	156.00	20,461.32	7.2	6.44	0.76	131
rivaroxaban (20 mg)	526.22	20,461.32	0.526	-2.05	2.57	39
	526.22	20,461.32	0.72	-1.85	2.57	39
	526.22	20,461.32	7.2	4.63	2.57	39
Warfarin (5mg)	2.22	20,461.32	0.526	0.52	0.01	9,217
	2.22	20,461.32	0.72	0.71	0.01	9,217
	2.22	20,461.32	7.2	7.19	0.01	9,217
Warfarin (5mg) + INR	8.41	20,461.32	0.526	0.48	0.04	2,433
	8.41	20,461.32	0.72	0.68	0.04	2,433
	8.41	20,461.32	7.2	7.16	0.04	2,433

VTE: venous thromboembolism, ARR: absolute risk reduction, NNT: number needed to treat, INR: international normalized ratio

Table 2: Additional Cost-effectiveness Analysis for Enoxaparin and Rivaroxaban at Varying Costs for Treating Venous Thromboembolism

Drug	Cost of Drug, \$	Cost of Treating VTE, \$	Initial VTE Rate, %	Final VTE Rate, %	ARR, %	NNT
enoxaparin (40 mg)	156.00	20,461.32	0.526	-0.24	0.76	131
	156.00	30,000.00	0.526	0.01	0.52	192
	156.00	50,000.00	0.526	0.21	0.31	321
	156.00	70,000.00	0.526	0.30	0.22	449
	156.00	100,000.00	0.526	0.37	0.16	641
rivaroxaban (20 mg)	156.00	1,500,000.00	0.526	0.52	0.01	9,615
	526.22	20,461.32	0.526	-2.05	2.57	39
	526.22	30,000.00	0.526	-1.23	1.75	57
	526.22	50,000.00	0.526	-0.53	1.05	95
	526.22	70,000.00	0.526	-0.23	0.75	133
	526.22	100,000.00	0.526	0.00	0.53	190
	526.22	1,500,000.00	0.526	0.49	0.04	2,851

VTE: venous thromboembolism, ARR: absolute risk reduction, NNT: number needed to treat, INR: international normalized ratio