

Health Technology Review

Myoelectric and Microprocessor-Enabled Prostheses

Key Messages

What Is the Issue?

- Advanced prostheses offer people living with upper-limb or lower-limb amputations the potential for more complex movement compared to conventional or body-powered devices. However, advanced prostheses are expensive, require more training, and can require more maintenance than body-powered devices.
- A review of the literature can inform health care decision-making regarding these devices by summarizing their clinical benefits and cost-effectiveness compared to body-powered devices.

What Did We Do?

- To inform decisions regarding advanced prostheses for amputations, we conducted a Rapid Review to summarize evidence that compared the clinical effectiveness and cost-effectiveness of myoelectric and microprocessor-enabled prostheses to conventional or body-powered prostheses. We also sought to identify evidence-based guidelines regarding the use of myoelectric prostheses and microprocessor-enabled prostheses for this patient population.
- We searched key resources, including journal citation databases, and conducted a focused internet search for relevant evidence published since January 1, 2015.

What Did We Find?

- We found a total of 9 publications relevant for this review.
- Three cross-sectional studies evaluated the clinical effectiveness of myoelectric prostheses compared to body-powered prostheses. The findings suggested that myoelectric prostheses do not provide additional clinical benefits in physical function, quality of life, or satisfaction when compared to body-powered prostheses for adults with upper-limb amputations. However, the studies had limited internal and external validity, and they were likely underpowered. The study populations consisted mostly of white, male veterans in the US, with potential overlap between some of the identified studies.
- Two systematic reviews evaluated the clinical effectiveness of microprocessor-enabled prostheses (i.e., microprocessor knees) compared to body-powered prostheses. The findings suggested that, for above-the-knee amputations, microprocessor knees provide better or no additional clinical benefits in safety, physical function or mobility, quality of life, and satisfaction versus body-powered prostheses. However, there

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are many outcome measures used to assess safety and function across the literature, and results conflict depending on the measure used. Manufacturers were also involved in the conduct of 1 systematic review, while the other systematic review reported manufacturer involvement in the included studies.

- We did not identify any studies on the cost-effectiveness of myoelectric prostheses compared to body-powered prostheses for upper-limb amputations.
- One systematic review evaluated the cost-effectiveness of microprocessor-enabled prostheses (i.e., microprocessor knees). It concluded that microprocessor knees are cost-effective compared to nonmicroprocessor knees. However, the findings may not be generalizable to health systems in Canada, and there is considerable heterogeneity in willingness-to-pay thresholds and considered costs across the literature.
- One guideline on upper-limb amputation recommends body-powered prostheses or externally-powered prostheses (including myoelectric prostheses) to improve independence and reduce disability for people with upper-limb amputation (a weak recommendation based on very low certainty of evidence). It did not identify evidence to recommend 1 type over another.
- Two evidence-based guidelines recommend microprocessor knees based on evidence suggesting that they reduce falls, optimize function and mobility, enhance quality of life, and improve satisfaction. However, 1 guideline deemed the supporting evidence to be of very low quality and the recommendation to be weak, while the other guideline lacked a risk of bias assessment. The former guideline also recommends energy storing and return or microprocessor foot and ankle components over solid-ankle, cushioned-heel feet to improve ambulation and patient satisfaction (a weak recommendation based on very low-quality evidence).

What Does This Mean?

- Microprocessor-enabled prostheses, specifically those with microprocessor knees, may provide more or no additional clinical benefits and may be more cost-effective than conventional prostheses for adults with above-the-knee amputations. However, the literature was assessed to be of low quality, with considerable heterogeneity in

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outcomes. It is unclear how generalizable these findings are to health systems in Canada.

- Limited and low-quality evidence suggests that myoelectric prostheses and body-powered prostheses do not provide additional clinical benefits. Additionally, the comparative cost-effectiveness of these devices remains unclear.
- Evidence-based guidelines underscore the importance of patient-centred care and shared decision-making for people living with an amputation. Clinicians may wish to account for patient factors — such as their activity levels and needs, preferences, and access to rehabilitation services — when prescribing a prosthesis.
- Previous research has identified disproportionately higher rates of lower-limb amputations in remote areas, in neighbourhoods of low social capital or low socioeconomic status, and among Indigenous Peoples living in Canada, due to unmet health care needs. However, inadequate reporting of population characteristics in the included studies limited the ability to make conclusions about the applicability of findings for people with an amputation in these underserved populations.

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Abbreviations

DOF	degree of freedom
GRADE	Grading of Recommendations Assessment, Development and Evaluation
QALY	quality-adjusted life-year
SF-36	Short Form (36) Health Survey

Key Terminology

Indigenous Peoples: People and communities who identify with and have historical claim as “First Peoples” who have been on these lands (colonially known as Canada and the US) since time immemorial. *Indigenous Peoples within Canada* often refers to people who belong to First Nations, Inuit, and Métis communities; however, we acknowledge that all Indigenous communities are widely heterogeneous, having distinct social, economic, and political systems, as well as distinct languages, cultures, and beliefs.^{1,2}

Research Questions

1. What is the clinical effectiveness and safety of myoelectric prosthesis versus body-powered prosthesis for people with an upper-body amputation?
2. What is the clinical effectiveness and safety of microprocessor-enabled prosthesis versus body-powered prosthesis for people with a lower-body amputation?
3. What is the cost-effectiveness of myoelectric prosthesis versus body-powered prosthesis for people with an upper-body amputation?
4. What is the cost-effectiveness of microprocessor-enabled prosthesis versus body-powered prosthesis for people with a lower-body amputation?
5. What are the evidence-based guidelines regarding the use of myoelectric prosthesis or microprocessor-enabled prosthesis for people with upper-body or lower-body amputations, respectively?

Context and Policy Issues

Upper-Limb Amputations

In 2013, it was estimated that approximately 6,800 people in Canada had undergone an amputation proximal to the wrist.³ Trauma is the most common cause of upper-limb amputations.⁴ Other less common causes of upper-limb amputations in adults include infection (e.g., from diabetes or immunodeficiency), ischemic disease, and cancer.⁴ When replantation or reconstruction is not feasible, clinicians proceed with an upper-limb amputation.⁴ Levels of upper-limb amputation include interscapular thoracic (i.e., up to shoulder girdle), shoulder disarticulation (i.e., through the shoulder joint), transhumeral (i.e., above the elbow), elbow disarticulation (i.e., through the elbow joint), transradial (i.e., below the elbow), and hand and wrist disarticulation (at the wrist).⁵

Upper-Limb Prostheses

People with an upper-limb amputation may use a body-powered prosthesis or an externally-powered prosthesis. A body-powered prosthesis can be controlled using body motions, via a cable traversing from a harness, whereas externally-powered prostheses have at least 1 motorized joint powered by a battery.⁶ The most common type of externally-powered device is a myoelectric prosthesis.⁶ Myoelectric devices

use electromyography surface electrodes embedded in the socket to convert signals from the muscle to control movement in the motorized joint.^{6,7} However, externally-powered prostheses can use other control inputs, such as force sensitive resistors, linear transducers, toggles, rocker switches, and inertial measurement units.⁶

Prostheses also include a terminal device, which is the end component that interacts with the environment.⁸ For upper-limb amputations, terminal devices function as the hand of the prosthesis. The 'degrees of freedom' (DOFs) describe the capabilities of terminal devices.⁷ Single-DOF myoelectric prostheses indicate that the terminal device can open and close, while multi-DOF myoelectric prostheses can perform more complex functions typical of the hand.⁷ Myoelectric prostheses are known to require more training for use than body-powered prostheses, given their potential for more complex function.⁷ They are also typically heavier, less durable (more susceptible to damage from moisture or vibration), and more expensive than body-powered prostheses.⁷ A 2013 budget impact analysis found that the average annual total cost, average annual cost of prosthesis components, and operation costs were higher for myoelectric devices compared to body-powered prostheses, based on data from 28 individuals in British Columbia.⁹ The annual average total prosthetic cost was more than \$35,000 for myoelectric prostheses for the first year of use, while it was approximately \$15,000 for body-powered prostheses.⁹ The first year of use represented more than 50% of the total cost of prosthesis use within the 5-year time frame of their analysis.⁹

Lower-Limb Amputations

Lower-limb amputations are largely caused by long-term and unresolved complications of peripheral artery disease and diabetes mellitus.¹⁰⁻¹⁴ The Canadian Institute of Health Information estimated that there were 7,720 lower-limb amputations per year associated with diabetes in adults living in Canada between 2020–2021 and 2022–2023.¹¹ Lower-limb amputations in people with diabetes are typically preventable and reflect unmet health care needs.¹¹ Health systems around the world, including Canada, use rates of leg amputations as a measure of diabetes care quality.¹¹ Types of lower-limb amputation include hip disarticulation (through the hip joint), knee disarticulation (through the knee joint), transtibial (below the knee) or transfemoral (above the knee).^{15,16} Postoperative recovery rehabilitation for lower-limb amputations involving prosthesis can vary and involves many stages, such as prosthesis fitting, prosthesis management, and prosthesis training so that individuals can resume daily activities and reintegrate into their community.¹⁵ The length of rehabilitation can vary by level of amputation and rehabilitation centre,¹⁷ but it can take up to 12 to 18 months.¹⁵

In 2024, the Canadian Institute of Health Information published a report highlighting considerable health inequities in diabetes-associated leg amputations.¹¹ Their analysis found higher rates of diabetes-associated leg amputations in males, individuals living in the lowest-income neighbourhoods, individuals living in neighbourhoods with the lowest rates of high school completion, and individuals living in neighbourhoods with the highest social isolation.¹¹ They also noted that rates of leg amputation increase with increasing remoteness.¹¹ They attributed this phenomenon to lower access to health providers that deliver critical preventive services in remote areas.¹¹ These health inequities remain significant after adjusting for diabetes prevalence (i.e., more prevalent among males and populations in neighbourhoods with lower incomes and areas with lower levels of education).¹¹

Indigenous Peoples in Canada have disproportionately higher rates of lower-limb amputations compared to non-Indigenous populations.¹⁸⁻²⁰ Authors of a study conducted in Saskatchewan reported that the rate of amputations is 1.7 times higher among First Nations individuals registered under the *Indian Act* compared to the non-Indigenous population.¹⁹ While diabetes-related foot complications are higher in Indigenous males than Indigenous females, both sexes are at higher risk of lower-limb amputations at a younger age compared to non-Indigenous populations in Canada.¹⁸ A scoping review reported that the mean age for lower-limb amputations in Indigenous Peoples is approximately 14 years younger than the non-Indigenous population.¹⁸ Disproportionate rates of lower-limb amputation and diabetes in Indigenous Peoples reflect their insufficient access to culturally-informed, specialized, and preventive care, as well as the documented barriers — including racism, discrimination, and marginalization — within the health care systems in Canada.^{18,21}

Lower-Limb Prostheses

Lower-limb prostheses can include multiple components, such as a socket, knee, shin or pylon, foot, and ankle.¹⁵ The prosthesis can either be endoskeletal or exoskeletal. The former means that components may be left uncovered or hidden inside a cosmetic cover for easy replacement or alignment changes, whereas the latter has a rigid exterior.¹⁵ Microprocessor-enabled prostheses have microprocessor components, such as the knees. Microprocessor knees allow for faster knee adjustments and a more natural gait compared to other types of prosthetic knees.^{15,22} They can differ in which phases of gait are controlled and how the phase may be controlled.¹⁵ They also require regular maintenance and strict adherence, and have been reported to be heavier than nonmicroprocessor knees.¹⁵ Conventional prostheses without microprocessors move via mechanical adjustment or are weight-activated (e.g., single-axis knees, locking knees, stance-control “safety” knees, polycentric knees, and pneumatic or hydraulic knees).^{15,22} The cost of lower-limb prostheses can vary depending on the level of amputation and function. The US Department of Veterans Affairs estimates that the 5-year projected cost of lower-body prostheses ranges from US\$82,251 to US\$228,665 (inclusive of microprocessor and nonmicroprocessor knees).²³ In general, microprocessor knees are more costly than nonmicroprocessor knees.²⁴

Rehabilitation Services for Amputations and Prosthesis Coverage in Canada

The high cost of prostheses, especially those with more advanced technologies, is a considerable barrier to access for people living with amputations.^{23,25} In addition to the device itself, people need to consider costs associated with device maintenance and repairs, as well as rehabilitation and training (e.g., physical therapy and occupational therapy).²⁶ Training can include balance and coordination training, gait training, muscle strengthening, cardiovascular training, and prosthesis education.¹⁷

Coverage for advanced prostheses, such as myoelectric and microprocessor knees, remains limited and varies across jurisdictions in Canada.^{23,25} While some coverage exists, people living with an amputation are still likely to rely on personal resources, private insurance, fundraising, or funding from nongovernmental organizations for access to a prosthesis and necessary care.²³ Nongovernmental bodies include groups that represent people living with amputations, such as the Ottawa Amputee Society and the War Amps.¹⁷

An Environmental Scan identified that there are at least 36 regional sites that provide rehabilitation services for amputations in Canada.²⁷ However, the findings suggest that people living with amputations may have

different experiences between these centres because they can vary in clinician availability, access to prostheses (e.g., prosthesis fabrication, financial assistance benefits), and other services (e.g., mental health and peer support).²⁷ Rehabilitation centres may also offer other types of therapy, such as aquatic therapy, stress management, phantom pain and body image education, and smoking cessation programs.^{17,27}

Why Is It Important to Do This Review?

Clinicians and decision-makers may be uncertain about the clinical effectiveness and cost-effectiveness of advanced prostheses compared to body-powered prostheses, specifically myoelectric and microprocessor-enabled prostheses for upper-body and lower-body amputations, respectively. A review of the evidence can help inform decision-making regarding advanced prostheses for people with an upper-body or lower-body amputation compared to body-powered prostheses.

Objectives

In response to an external request, we prepared this Rapid Review that summarizes and critically appraises available evidence to inform decision-making regarding the clinical effectiveness and cost-effectiveness of:

- myoelectric prostheses compared to body-powered prostheses for upper-body amputations
- microprocessor-enabled prostheses compared to body-powered prostheses for lower-body amputations.

This review also summarizes recommendations from evidence-based guidelines regarding the use of myoelectric prostheses or microprocessor-enabled prostheses for this patient population.

Methods

An information specialist conducted a customized literature search, balancing comprehensiveness with relevance, of multiple sources and grey literature on July 14, 2025.

One reviewer screened citations and selected studies based on the inclusion criteria presented in [Table 1](#), and critically appraised included publications using 3 critical appraisal tools. For this Rapid Review, systematic reviews must have a research question, reproducible strategy, inclusion and exclusion criteria, screening methods, critical appraisal or risk of bias assessment, and information about data analysis and synthesis.²⁸ Additionally, health technology assessments must be informed by a systematic review. Of note, we did not conduct engagement with people living with amputations in Canada for this Rapid Review.

[Appendix 1](#) presents a detailed description of methods and selection criteria for included studies.

Table 1: Selection Criteria

Criteria	Description
Population	Q1, Q3, Q5: People with upper-body amputation(s) Q2, Q4, Q5: People with lower-body amputation(s)
Intervention	Q1, Q3, Q5: Myoelectric prosthesis Q2, Q4, Q5: Microprocessor-enabled prosthesis
Comparator	Q1 to Q4: Body-powered prosthesis (or conventional prosthesis) Q5: Not applicable
Outcomes	Q1, Q3: Clinical effectiveness (e.g., quality of life, function [e.g., activities of daily living, mobility], adverse events [e.g., falls], length of use, and acceptance rate of prosthesis) Q2, Q4: Cost-effectiveness (e.g., ICER) Q5: Recommendations regarding prosthetic use (e.g., appropriate type of prosthesis)
Study designs	Health technology assessments, systematic reviews, randomized controlled trials, nonrandomized studies, economic evaluations, and evidence-based guidelines
Publication date	Since January 1, 2015

ICER = incremental cost-effectiveness ratio.

Note: For research questions 1 to 4, we limited study designs of interest to systematic reviews, including those systematic reviews within health technology assessments. When no systematic reviews were available, we included primary studies that met the review's eligibility criteria.

Summary of Evidence

Quantity of Research Available

This report includes 9 publications that met our inclusion criteria, including 3 systematic reviews,²⁹⁻³¹ 3 nonrandomized studies,³²⁻³⁴ and 3 guidelines.^{6,35,36}

For question 1, we did not identify any relevant systematic reviews. To address this gap, we included the 3 nonrandomized studies identified from the search results.³²⁻³⁴

We identified 2 systematic reviews relevant to question 2.^{29,30} These systematic reviews overlapped on 3 primary studies, where 1 systematic review³⁰ narratively summarized its findings and the other reported quantitative results.²⁹ Hence, results from both systematic reviews are reported in this Rapid Review.^{29,30} A citation matrix describing the degree of overlap between primary studies is presented in Appendix 6.

We found 1 systematic review that aimed to address questions 3 and 4.³¹ It had broad selection criteria by including economic evaluations that evaluated the cost-effectiveness of any prosthesis-related devices for upper-limb or lower-limb amputations.³¹ This systematic review found no economic evaluations on devices for upper-limb amputations;³¹ however, the review identified literature on the cost-effectiveness of microprocessor-enabled prostheses (i.e., microprocessor knees) versus body-powered prostheses, osseointegrated versus socket-suspended prostheses, and different types of transtibial sockets.³¹ Of the 6 economic evaluations on microprocessor knees, 4 met the inclusion criteria of this Rapid Review.³¹ Only the characteristics and results of these relevant studies are described in this report.

We identified 3 evidence-based guidelines relevant to question 5.^{6,35,36} We reported on the characteristics and results from the subset of relevant studies. Appendix 2 presents the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA)³⁷ flow chart of the study selection.

Summary of Study Characteristics

Summaries of study characteristics are organized by research question. [Appendix 3](#) provides details regarding the characteristics of included publications.

Included Studies for Question 1: Clinical Effectiveness of Myoelectric Prostheses Versus Body-Powered Prostheses

We identified 3 cross-sectional studies that evaluated the clinical effectiveness of myoelectric prostheses.³²⁻³⁴ We included these studies post hoc, given the lack of relevant systematic reviews for question 1. All 3 studies involved people with upper-limb amputations residing in the US. Of these 3 studies, 2 recruited veterans with at least 1 upper-limb amputation who received care from the US Department of Veterans Affairs or Department of Defense between 2010 and 2015.^{33,34} The remaining study recruited people with unilateral and bilateral upper-limb amputations seen at 5 US sites (85% were veterans).³² The US government, specifically the US army, funded all 3 cross-sectional studies.³²⁻³⁴

Across these 3 cross-sectional studies, the study population were mostly white, non-Hispanic, male veterans older than 50 years of age.³²⁻³⁴ Trauma was a major cause of amputations (i.e., combat, accident, and burn).³²⁻³⁴ None of the studies defined gender or sex and none reported population characteristics by socioeconomic status, place of residence, religion, occupation, social capital, or education.³²⁻³⁴

Two cross-sectional studies^{32,33} separated myoelectric prosthesis users into 2 subgroups for analysis: single-DOF and multi-DOF. DOF describes the terminal device used by the study arm.^{32,33} These 2 studies aligned in what they considered a single-DOF and multi-DOF terminal device.^{32,33} Additionally, 2 studies classified hybrid devices as myoelectric.^{32,34}

One study compared the impact of the use of a prosthesis versus nonuse of a prosthesis on outcomes,³³ while 2 studies also included cosmetic devices.^{33,34} These comparisons are beyond the scope of this report; thus, we reported results when the analysis included comparisons relevant for our review.

Two studies compared the impact on physical function and mobility (e.g., dexterity, activities of daily living, independence, and disability measures), as well as quality of life.^{32,33} Additionally, 2 studies compared user satisfaction between myoelectric and body-powered users.^{32,34} One study compared the impact of these devices on social wellness (via the Community Reintegration of Injured Service Members computer-adapted test) of the study population.³²

[Table 2](#) provides a detailed summary of the characteristics of the 3 cross-sectional studies for question 1.

Included Studies for Question 2: Clinical Effectiveness of Microprocessor-Enabled Versus Body-Powered Prostheses

We identified 2 systematic reviews that evaluated the clinical effectiveness of microprocessor-enabled prostheses versus body-powered prostheses, specifically microprocessor knees compared to nonmicroprocessor knees.^{29,30}

One systematic review compared the impact of these devices on safety, function or performance, and satisfaction in people with above-the-knee amputations classified as Medicare functional classification level 2 (low mobility or limited community ambulator).²⁹ Level 2 indicates that the individual using the prosthesis “has the ability or potential for ambulation with the ability to transverse low level environmental barriers such as curbs, stairs or uneven surfaces. This level is typical of the limited community ambulator.”³⁸ The systematic review authors found a total of 15 studies (all relevant to the present review), with a total of 704 participants.²⁹ The follow-up period ranged from 1 week to 6 months across the included studies.²⁹ The study population was mostly male (76.9%), with a smaller proportion of females (22.9%).²⁹ The systematic review included a meta-analysis with outcome measures reported in at least 3 primary studies, specifically:

- safety (i.e., number of falls, fear of falling, Timed Up and Go test)
- function and mobility (i.e., positive mobility grade change, walking speed, fast walking speed)
- satisfaction-related questions from the General Prosthesis Evaluation Questionnaire (i.e., ambulation, utility, appearance, residual limb, sounds, utility, well-being).²⁹

The other systematic review included studies on people with unilateral transfemoral amputation.³⁰ This systematic review included 18 studies (17 relevant to the present review) with a total of 993 participants. Of the included studies, the study population was composed mostly of males (77.1%).³⁰ However, this systematic review did not define or differentiate sex and gender. The mean age of the population ranged from 38.5 years to 69 years, and the follow-up period ranged from 1 week to 6 months across the included primary studies.³⁰ The systematic review authors compared the impact of microprocessor knees to nonmicroprocessor knees on mobility and quality of life.³⁰

None of the systematic reviews^{29,30} reported population characteristics by socioeconomic status, place of residence, religion, occupation, social capital, and education. It is unclear whether primary studies included in these systematic reviews reported on these characteristics.

[Table 3](#) provides a detailed summary of the characteristics of included systematic reviews for question 2.

Included Studies for Question 3: Cost-Effectiveness of Myoelectric Versus Body-Powered Prostheses

We did not identify any publications that evaluated the cost-effectiveness of myoelectric versus body-powered prostheses. Therefore, we could not provide a summary.

Included Studies for Question 4: Cost-Effectiveness of Microprocessor Knees Versus Body-Powered Prostheses

We included 1 systematic review of economic evaluations that compared the cost-effectiveness of microprocessor knees versus mechanical knees (i.e., body-powered prostheses) in people with lower-extremity amputations.³¹ The systematic review authors included 12 economic evaluations (4 relevant to this Rapid Review).³¹ Of the relevant publications, 3 evaluations used a payer's perspective in Italy, Sweden, and Denmark, and the remaining economic evaluation was conducted in the US with a societal perspective.³¹ Three of the included economic evaluations specifically evaluated the cost-effectiveness of microprocessor knees (C-Leg), whereas the remaining economic evaluation did not specify a specific brand or type of microprocessor knees.³¹

Direct and indirect costs varied across studies.³¹ Direct costs may include hospital stays, medications, rehabilitation-related visits, fitting time, diagnostics, and device service and maintenance.³¹ One of the included economic evaluations was limited to fitting time and service costs.³¹ Indirect costs can include transportation, lodging, patient and family or caregiver expenses, productivity losses, and lost wages. Additionally, the time horizon ranged from 5 years to 10 years across relevant economic evaluations.³¹

The systematic review did not describe the population characteristics of their study population.³¹ [Table 3](#) provides a detailed summary of the characteristics of the systematic review for question 4.

Included Studies for Question 5: Guidelines Regarding the Use of Myoelectric Prostheses or Microprocessor-Enabled Prostheses

[Table 4](#) provides a detailed summary of the characteristics of included guidelines for question 5.

Guidelines for Upper-Limb Amputations

The US Department of Veterans Affairs and Department of Defense published 1 evidence-based guideline in 2022 for adults with upper-limb amputations.⁶ They considered a variety of interventions for upper-limb amputations, such as prevention and treatment for residual limb pain, prostheses, and psychosocial interventions.⁶ They developed this guideline for health care providers, such as rehabilitation care providers, physicians, therapists, and prosthetists.⁶ Focus groups sought the perspectives of the population of interest receiving care from the Department of Veterans Affairs or the Department of Defense to inform the guideline.⁶

The guideline development group considered benefits and harms of interventions — such as functional status, quality of life, satisfaction, independence, pain, and mental health — from the literature.⁶ The quality of individual studies was determined using the US Preventive Services Task Force method.⁶ The overall quality of the body of evidence was determined using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach, which considers overall study quality or risk of bias, consistency of evidence, directness of evidence, and precision of evidence.⁶ The quality of the body of evidence is rated as high, moderate, low, or very low.⁶ The strength and direction of the recommendations was also determined using the GRADE approach, which considers the confidence in the quality of the evidence, the balance of desirable and undesirable outcomes, patient values and preferences, and other implications, such as feasibility and acceptability.⁶ The strength and direction of the recommendations

is rated as strong for, weak for, neither for nor against, weak against, and strong against.⁶ It is unclear what process the guideline development group used to agree or resolve conflicts about decisions for this guideline.⁶

Guidelines for Lower-Limb Amputations

Two evidence-based guidelines published in 2019³⁶ and in 2024³⁵ for people with lower-limb amputations (acquired congenitally,^{35,36} from trauma,^{35,36} or from dysvascular issues³⁶) were included in the current review.^{35,36} One guideline specifically focused on people with unilateral amputation at the knee disarticulation or transfemoral level.³⁶ One guideline was developed for health care providers, community providers, and the US Department of Veterans Affairs or Department of Defense,³⁵ while the other was developed for health care providers and policy-makers.³⁶ Both guidelines were developed in the US,^{35,36} but 1 was specifically developed by the US Department of Veterans Affairs and Department of Defense.³⁵ The same guideline was informed by findings from a focus group that gathered perspectives from people receiving care via the US Department of Veterans Affairs and Department of Defense.³⁵ The other guideline lacked details about whether individuals were engaged in guideline development.³⁶ The general outcomes of interest were the benefits and harms of rehabilitation or treatment strategies,^{35,36} such as functional status,³⁵ quality of life,³⁵ satisfaction,³⁵ and falls.³⁵

One guideline lacked assessment of the quality of individual studies, quality of the body of evidence, or the strength of the recommendations.³⁶ The other guideline used the US Preventive Services Task Force method to assess the quality of individual studies.³⁵ The same guideline used the GRADE approach to assess the quality of the body of evidence.³⁵ The quality of the evidence is rated as high, moderate, low, or very low.³⁵ The strength and direction of the recommendations was also determined using the GRADE approach.³⁵ The strength and direction of the recommendations is rated as strong for, weak for, neither for nor against, weak against, and strong against.³⁵

Summary of Critical Appraisal

[Appendix 4](#) provides additional details about the strengths and limitations of the included publications.

Included Studies for Question 1: Clinical Effectiveness of Myoelectric Prostheses Versus Body-Powered Prostheses

All cross-sectional studies clearly reported their objective, main outcomes, population characteristics, interventions of interest, and findings.³²⁻³⁴

However, the included cross-sectional studies had limited internal validity due to their nonrandomized design, as well as the participants' and researchers' awareness of the intervention. The nature of intervention limited the ability to conceal treatment from participants.

One study used a convenience sample for participant recruitment, which put the study at risk of selection bias.³² The same study described potential confounders among the study population, but did not evaluate or investigate their impact on the study's findings (e.g., age, training for prosthesis, and terminal device type).³² The remaining 2 studies identified (via a regression model) and adjusted for confounding variables

in their analysis of main outcomes.^{33,34} While researchers attempted to capture prosthesis use training as a potential confounding variable, they used a binary question with answers limited to “yes” or “no.”^{33,34} This binary question provided limited insight into an individual’s experience and comfort with their prosthesis. Both studies used a variety of outcomes, but researchers did not adjust for multiplicity.^{33,34}

Furthermore, the findings of 1 study may have been impacted by misclassification bias.³³ Researchers placed individuals with missing data on the number of the terminal device into the single-DOF group.³³ It is possible that researchers included individuals using myoelectric prostheses in the single-DOF group. It is unclear how this may have impacted their findings for the myoelectric prostheses.³³

All 3 studies had a small sample size and potentially lacked the power to detect a statistically significant effect.³²⁻³⁴ Additionally, these 3 cross-sectional studies recruited a study sample composed mostly of veterans that were white, non-Hispanic, male, and older than 50 years of age.³²⁻³⁴ While these studies were likely funded to inform decisions for this population of interest, their findings may not be generalizable to all individuals with upper-limb amputations, such as females and younger adults. It is also unclear how the study sample’s access to devices and experience with health care systems align with individuals seeking prosthesis-related care in Canada.³²⁻³⁴

Included Studies for Question 2: Clinical Effectiveness of Microprocessor-Enabled Prostheses Versus Body-Powered Prostheses

Both systematic reviews detailed their research questions and provided some details regarding primary studies.^{29,30} The systematic review by Hahn et al.²⁹ did not have an explicit statement about established methods before the conduct of the review. The same systematic review mentioned a preparatory literature search, but did not detail their process or results, or how this was used to inform their search strategy.²⁹ Neither systematic review justified its selection criteria.^{29,30} The systematic review by Thibaut et al.³⁰ lacked details about their search time frame and limited inclusion criteria to studies with 20 or more participants without justification. Selection bias may have impacted the findings of both reviews.^{29,30}

The systematic review by Thibaut et al.³⁰ may also have been impacted by reporting bias. The systematic review lacked reporting of quantitative results from individual studies: the authors narratively summarized the main findings from each study.³⁰ Additionally, the systematic review authors did not provide details on how they defined no difference, favourable results, or unfavourable results for most of their reported qualitative findings.³⁰

The systematic review by Thibaut et al.³⁰ described the findings of their risk of bias assessments. However, the systematic review by Hahn et al.²⁹ did not consider the impact of confounding variables — such as amputation type, bilateral versus unilateral amputations, years of use, or user training and experience with devices — in their discussion of included studies and their meta-analysis. The same systematic review lacked exploration of the impact of publication bias,²⁹ which was limited by the small number of studies included for outcomes in the meta-analysis. Additionally, Hahn et al.²⁹ also acknowledged that the small number of studies pooled for meta-analysis limited the ability to identify sources of heterogeneity.

Both systematic reviews lacked details regarding the location of the included studies.^{29,30} Thus, it is unclear whether the findings of both reviews are generalizable to health settings and individuals with amputations in Canada. Further, the systematic review by Hahn et al.²⁹ predominately evaluated microprocessor knees with specific functions. Their review findings may not be generalizable to all microprocessor knees.

Some authors of the systematic review by Hahn et al.²⁹ were employees of manufacturers of microprocessor knees. Additionally, manufacturers also funded some of the primary studies included in the review by Thibaut et al.³⁰ These findings should be interpreted with caution as study conduct and interpretation of results may have been influenced by these conflicts of interest.

Included Studies for Question 3: Cost-Effectiveness of Myoelectric Prostheses Versus Body-Powered Prostheses

We did not identify any publications that evaluated the cost-effectiveness of myoelectric versus body-powered prostheses. Therefore, we did not conduct a critical appraisal for question 3.

Included Studies for Question 4: Cost-Effectiveness of Microprocessor-Enabled Prostheses Versus Body-Powered Prostheses

The systematic review authors clearly detailed their objective, but they did not explicitly include a statement regarding established methods or provide their rationale for the exclusion criteria (e.g., studies conducted in languages other than English)³¹ Selection bias may have impacted findings of this review.³¹ Additionally, the publication did not provide details regarding funding sources. It is unclear whether funding sources may have influenced the study conduct.

The systematic review authors used a satisfactory technique to assess risk of bias, which included an assessment of funding sources of each included economic evaluation.³¹ However, they did not discuss their findings within the context of their bias assessment results.³¹ It is possible that findings were misleading without discussing the limitations of the included evaluations.

Most economic evaluations focused on the cost-effectiveness of the C-Leg microprocessor knee versus mechanical knees.³¹ It is unclear whether the findings of this systematic review apply to all microprocessor knees.³¹ There was also considerable heterogeneity across the economic evaluations, including time horizon, direct and indirect costs considered, and threshold of acceptability.³¹

It is likely that these findings may not be applicable to health settings in Canada. The relevant economic evaluations were conducted outside of Canada, and most were conducted with a payer's perspective (3 of 4 relevant evaluations).³¹ Most economic evaluations did not consider indirect costs involved in the natural history of amputations and prosthesis use, such as rehabilitation and training costs.³¹ It is also unclear whether economic evaluations considered contexts of transitioning to new devices (i.e., from mechanical knees to microprocessor knees) or cases in which individuals discontinued an advanced prosthesis to return to their previous model (i.e., a mechanical knee).³¹

Included Studies for Question 5: Guidelines Regarding the Use of Myoelectric Prostheses or Microprocessor-Enabled Prostheses

Guidelines for Upper-Limb Amputations

The guidelines clearly described their scope and purpose, the health professionals involved in development, and the guidelines' target users.⁶ They clearly detailed the methods of selecting articles based on inclusion and exclusion criteria.⁶ All recommendations were specific, unambiguous, and easily identifiable.⁶ The guidelines discussed the applicability of the recommendations with consideration of key factors such as facilitators, barriers, and monitoring and auditing criteria, when applicable.

The guideline development group conducted focus groups to help ensure relevance and incorporate patient perspectives.⁶ However, individuals in the focus group were those who had either received or were currently receiving care from the US Department of Veterans Affairs and Department of Defense.⁶ Therefore, the perspectives could be limited and not representative of the care or experience of all individuals with upper-limb amputations receiving care. Additionally, it is possible that the guidelines did not capture all patient considerations.

The guideline development group consisted of individuals from relevant professional groups.⁶ A systematic literature search was conducted to search for literature to develop the guidelines.⁶ However, the guidelines reported limited details about the development group's decision-making process.⁶ Reporting these processes helps to understand how consensus was reached, and provides insight into how all members' perspectives were considered. Additionally, there was no record of the competing interest disclosures of the development group members. It is unclear whether conflicts of interest influenced the recommendations.

Guidelines for Lower-Limb Amputations

Both guidelines clearly described their scope and purpose, partners in the development of the guidelines, and their target users.^{35,36} All recommendations are specific, unambiguous, and easily identifiable.^{35,36} One guideline retrieved relevant studies from multiple databases,³⁵ while the other included 1 database.³⁶ The latter guideline's systematic search may have been impacted by selection bias, and may have missed relevant literature given that the search was limited to 1 database.³⁶

The views and preferences of target users were sought through a focus group in 1 guideline, which helped to ensure relevance and incorporate patient-centred perspectives.³⁵ The focus group included those who received or were currently receiving care from the US Department of Veterans Affairs and Department of Defense.³⁵ Therefore, the perspectives could be limited and not representative of the care or experience of all individuals with lower-limb amputations. Additionally, it is possible that the guidelines did not capture all patient considerations. The other guideline did not consider patient perspectives, which could limit its relevance and applicability to its target population.³⁶

While 1 guideline assessed the strength of evidence and the recommendation,³⁵ the other guideline did not.³⁶ It is unclear whether the latter guideline considered the biases and limitations of the literature to inform their recommendations.³⁶ The same guideline lacked details about the clinical perspectives that were considered in guideline development.³⁶ Neither guideline detailed the methods to reach consensus, which is necessary

to understand how decision-making and members' perspectives were considered.^{35,36} Further, the guideline by Stevens and Wurdeman³⁶ did not discuss factors such as facilitators, barriers, monitoring, and auditing criteria that could impact the application of recommendations in practice.

The guideline by the US Department of Veteran Affairs³⁵ provided no record of the competing interest disclosures from the guideline development group. However, they did report their processes to identify competing interests.³⁵ It is unclear whether conflicts of interests influenced decision-making and the recommendations. While the other guideline stated “none” for funding sources, the authors worked in a prosthetics clinic, which could have influenced their recommendations.³⁶

Summary of Findings

[Appendix 5](#) presents additional details regarding the main study findings.

Question 1: Clinical Effectiveness of Myoelectric Prostheses Versus Body-Powered Prostheses

Physical Function and Mobility

For unilateral amputations, Resnik et al. (2020)³³ found that both single-DOF and multi-DOF myoelectric prostheses resulted in no significant difference in physical function outcomes (i.e., Quick Disabilities of Arm, Shoulder, and Hand Score; help needed for activities of daily living) versus body-powered prostheses.

Another study aimed to identify whether there are differences in dexterity between users of single-DOF myoelectric prostheses, multi-DOF myoelectric prostheses, and body-powered prostheses, in people with transradial or transhumeral amputations.³² Of note, a significant difference in this study indicated a statistically significant difference between all devices, but it did not provide insight as to which device performed the best out of all prostheses considered via statistical methods.³² For unilateral transhumeral amputations, a significant difference remained after adjustment for multiple outcomes of the Jebsen-Taylor Hand Function assessment, specifically the small objects and 9-hole peg outcomes.³² However, no difference was detected for other dexterity outcomes within the Jebsen-Taylor Hand Function assessment.³² Additionally, no outcomes remained clinically significant after adjustment when considering unilateral and bilateral transhumeral amputations.³² Further, there were no differences identified in adults with transhumeral unilateral amputations for other measures of physical function (i.e., brief activities measure for upper limb amputations; activities measure for the upper-limb amputation; timed measure of activity performance for individuals; Quick Disabilities of the Arm, Shoulder, and Hand score; help needed for activities of daily living).³²

The same study also identified a significant difference (after adjustment) in the 9-hole peg, box and blocks, and small objects outcomes for the Jebsen-Taylor Hand Function assessment between single-DOF myoelectric prostheses, multi-DOF myoelectric prostheses, and body-powered prostheses, for bilateral and unilateral transradial amputations.³² For people with a unilateral transradial amputation, it also identified a significant difference in the heavy cans, 9-hole peg, and small objects outcomes.³² Additionally, it found a significant difference for the brief activities measure for upper limb amputations in people with unilateral transradial amputations.³² However, no significant difference was identified for other measures of physical

function (i.e., activities measure for the upper limb; timed measure of activity performance for individuals; Quick Disabilities of the Arm, Shoulder, and Hand; help needed for activities of daily living) for individuals with unilateral transradial amputations.³²

Quality of Life

For unilateral amputations, Resnik et al. (2020)³³ found no significant difference in scores between body-powered prostheses and myoelectric devices, regardless of the number of DOFs, for the Veterans RAND 12-Item Health Survey physical and mental components. For the same components of the Veterans RAND 12-item Health Survey, another study found no statistically significant difference for people with transradial amputations or transhumeral amputations.³²

Satisfaction

For bilateral and unilateral amputations, Resnik et al. (2020)³⁴ found no significant difference in satisfaction levels between myoelectric and body-powered prosthesis users. Another study found no significant difference in satisfaction between users of single-DOF myoelectric prostheses, multi-DOF myoelectric prostheses, and body-powered prostheses, in people with unilateral transradial or unilateral transhumeral amputations (i.e., Community Reintegration of Injured Service Members computer-adapted test, Trinity Amputation and Prosthesis Experience Satisfaction Scale).³² Of note, the authors of the same study acknowledged that these measures focus on device attributes, and neither measures satisfaction with prosthesis function.³⁴

Social Health

One study found a statistically significant difference in Community Reintegration of Injured Service Members computer-adapted test scores, specifically in perceived difficulty in participation, between users of single-DOF myoelectric prostheses, multi-DOF myoelectric prostheses, and body-powered prostheses, in people with transradial amputations.³² The same study found no significant difference for the same outcome in people with unilateral transhumeral amputations. Additionally, no statistically significant difference was identified for extent of participation for people with unilateral transhumeral or unilateral transradial amputation.³²

Question 2: Clinical Effectiveness of Microprocessor-Enabled Prostheses Versus Body-Powered Prostheses

General Prosthesis Use

The systematic review by Thibaut et al.³⁰ found 1 study that suggested there was no difference in Questionnaire for Persons with Transfemoral Amputations scores between those with microprocessor knees and those with nonmicroprocessor knees.

Safety

The meta-analysis results by Hahn et al.²⁹ found statistically significant differences in favour of microprocessor knees versus nonmicroprocessor knees for all safety-related outcomes (11 studies), including number of falls (7 studies), fear of falling (6 studies), and Timed Up and Go (4 studies) in fixed-effects and random-effects models for limited community ambulators.

The systematic review by Hahn et al.²⁹ found a favourable effect for microprocessor knees versus nonmicroprocessor knees (9 studies). Of the 12 outcome measures for safety:

- 7 resulted in a statistically significant difference
- 4 did not report statistically significant differences
- 2 did not report statistical significance (e.g., P values).

The same systematic review found that none of the included studies showed a decline in safety with the use of microprocessor knees in limited community ambulators.²⁹

The systematic review by Thibaut et al.³⁰ found 1 study that showed no difference in the number of falls between microprocessor knees versus nonmicroprocessor knees. However, it also found 2 studies that showed a reduction in falls from changing to a microprocessor knee from a nonmicroprocessor knee.³⁰

Physical Function and Mobility

The systematic review by Hahn et al.²⁹ found all outcomes evaluating physical function and mobility favoured microprocessor knees over nonmicroprocessor knees in limited community ambulators; however, not all reported statistically significant results (15 studies). Of the 91 outcome measures, 39 results were statistically significant, while 20 resulted in a nonsignificant difference between microprocessor versus nonmicroprocessor knees.²⁹ Six measures resulted in nonsignificant and significant differences depending on the study.²⁹ The remaining measures did not report statistical testing results (e.g., P values).²⁹

Further, the results of their meta-analysis favoured microprocessor knees over nonmicroprocessor knees for walking speed (6 studies).²⁹ However, the same meta-analysis found no statistically significant difference for positive mobility grade changes (6 studies) or fast walking speed (3 studies).²⁹ The meta-analysis also found that satisfaction with ambulation was higher for microprocessor knees versus nonmicroprocessor knees in fixed and random models (4 studies).²⁹ For the Activity-Specific Balance Confidence Scale, the fixed-effects model results demonstrated a statistically significant improvement for microprocessor knees versus nonmicroprocessor knees, whereas the findings from the random-effects model did not demonstrate significant differences (3 studies).²⁹

The systematic review by Thibaut et al.³⁰ found conflicting evidence for the 6-minute walk test (2 studies), and no difference between microprocessor and nonmicroprocessor knees for the 10 m walk test (1 study). The systematic review found evidence to suggest no difference in general efficacy scores (1 study).³⁰ The same review found conflicting evidence regarding for the Locomotor Capabilities Index (3 studies) and mobility scores for the Prosthetic Limb Users Survey of Mobility (2 studies).³⁰ However, it identified studies that indicate higher activity levels (1 study), shorter timed up and go scores (1 study), hill mobility (1 study), and less sitting time (1 study) for microprocessor knees compared to nonmicroprocessor knees.³⁰

The same systematic review found no difference in results in the Assessment of Daily Activity Performance in Transfemoral Amputees Test between microprocessor and nonmicroprocessor knees in individuals living with transfemoral amputations classified to have low activity levels (1 study).³⁰ However, it found that individuals with intermediate and high activity levels needed less time to complete the same test (1 study).³⁰

One systematic review found faster gait speed with microprocessor versus nonmicroprocessor knees, but it also found no difference in stride length, knee extension and latency period, knee latency, and stance phase duration from 3D gait analysis (1 study).³⁰ The other systematic review found no difference in gait profile scores (1 study), electromyography signals during gait (1 study), and 3D gait analysis (1 study).²⁹

Satisfaction

The meta-analysis by Hahn et al.²⁹ revealed better satisfaction with utility for microprocessor knees compared to nonmicroprocessor knees for both fixed and random effects models (3 studies). However, the same meta-analysis found no statistically significant difference in terms of satisfaction with sounds (3 studies) or appearance (3 studies), as well as perceived health of the residual limb (3 studies) between microprocessor and nonmicroprocessor knees.²⁹

The same review²⁹ found evidence showing significantly better satisfaction with walking in individuals with high and intermediate activity levels for microprocessor knees compared to nonmicroprocessor knees (2 studies), as well as significantly better outcomes from the Quebec User Evaluation of Satisfaction with Assistive Technology when comparing these devices (1 study). However, the systematic review found no statistically significant differences in perceived social burden, perceived response by others, and frustration between microprocessor and nonmicroprocessor knees (1 study).²⁹

Quality of Life

Results of the meta-analysis by Hahn et al.²⁹ found no statistically significant difference in how people perceive their well-being (subscale in the prosthesis evaluation questionnaire) with microprocessor knees versus nonmicroprocessor knees (3 studies).

The systematic review by Hahn et al.²⁹ found significantly better scores for the mental component of the Short-Form (36) Health Survey (SF-36) with microprocessor knees versus nonmicroprocessor knees (1 study), but no difference in SF-36 physical component scores and overall scores (2 studies).²⁹ The systematic review by Thibaut et al.³⁰ found evidence to suggest that microprocessor knees improve overall SF-36 scores (2 studies), but found no difference in the following SF-36 subscales: general health, social role, emotional role, pain, vitality, mental, and physical component. For the SF-36 physical component summary, the same systematic review found conflicting evidence (2 studies).³⁰ For EQ-5D-5L scores, both systematic reviews identified evidence suggesting better scores with microprocessor knees (a total of 2 studies between the 2 systematic reviews).³⁰

Question 3: Cost-Effectiveness of Myoelectric Prostheses Versus Body-Powered Prostheses

We did not identify any relevant economic evaluations for question 3. Therefore, no summary could be provided.

Question 4: Cost-Effectiveness of Microprocessor-Enabled Prostheses Versus Body-Powered Prostheses

All 4 relevant economic evaluations in the systematic review found microprocessor knees to be cost-effective compared to nonmicroprocessor knees across different willingness-to-pay thresholds.³¹ The lowest incremental cost-effectiveness ratio reported from relevant economic evaluations was €3,218 per quality-

adjust life-year (QALY) and the highest was €40,155 per QALY, with acceptability thresholds of €10,000 per QALY and €54,120 per QALY, respectively.³¹

Question 5: Guidelines Regarding the Use of Myoelectric Prostheses or Microprocessor-Enabled Prostheses

Guidelines for Upper-Limb Amputations

The US Department of Veterans Affairs and Department of Defense guidelines suggested that body-powered or externally-powered prostheses be used for patients with major upper-limb amputations to improve independence and reduce disability.⁶ Of note, the guideline considered myoelectric prostheses to be externally-powered prostheses.⁶ The guideline development group reported the strength of the recommendation as weak, and the strength of the evidence as very low.⁶ Of note, supporting evidence for this recommendation included the 3 cross-sectional studies³²⁻³⁴ regarding myoelectric prostheses in this Rapid Review (i.e., addressing research question 1).

Guidelines for Lower-Limb Amputations

The US Department of Veterans Affairs and Department of Defense provided several recommendations on the use of microprocessor knee units, ankle components, and foot components for lower-limb amputations.³⁵ The recommendations, strength of the recommendations, and quality of the evidence are as follows:

- Prescribing microprocessor knee units over nonmicroprocessor knee units in prosthetic ambulators to reduce falls, optimize functional mobility, and improve patient satisfaction is suggested (weak recommendation based on very low-certainty evidence).³⁵
- There is insufficient evidence to prescribe any specific energy-storing and return or microprocessor foot and ankle component over others for prosthetic ambulators (neither for nor against the recommendation based on very low certainty evidence).³⁵
- Energy-storing and return or microprocessor-controlled foot and ankle components are suggested over solid-ankle, cushioned-heel feet in prosthetic ambulators to improve ambulation and patient satisfaction (weak recommendation based on very low-certainty evidence).³⁵

The guideline by Stevens and Wurdeman³⁶ also provided recommendations on the use of microprocessor knee units for lower-limb amputations. They did not assess the strength of recommendations or the evidence. The recommendations align with the recommendations for lower-limb amputations by the US Department Veteran Affairs and Department of Defense.³⁵ Compared to nonmicroprocessor knees, microprocessor knees re indicated:

- to reduce falls, stumbles, and associated frustrations, as well as the cognitive demands of ambulation³⁶
- to increase confidence while walking, self-reported mobility, satisfaction, well-being, and quality of life³⁶
- to increase self-selected walking speed, walking speed on uneven terrain, and metabolic efficiency during gait³⁶

- for limited community ambulators to enable increases in level-ground walking speed and walking speed on uneven terrain while substantially reducing uncontrolled falls and increased measured and perceived balance.³⁶

However, the same guideline found that microprocessor and nonmicroprocessor knees resulted in similar daily step counts, temporal spatial gait symmetry, self-reported general health, and total costs of prosthetic rehabilitation.³⁶ Therefore, the guideline recommends against the use of these parameters as primary indicators for prosthesis knee joint selection.³⁶

Limitations

Methodology and Engagement Approach

For research questions 1 to 4, we limited study designs of interest to systematic reviews published within the past 10 years, including systematic reviews within health technology assessments. When no systematic reviews were available, we mitigated this gap by including primary studies that met the Rapid Review's eligibility criteria. Further, we included evidence-based guidelines if they were published within the past 10 years to answer research question 5. The approach helped to balance short timelines while ensuring we could report on evidence for each research question, when available.

Given the needs of the requestor and internal capacity limitations, we did not conduct patient engagement, which would include individuals from underserved groups with disproportionately higher amputation rates (e.g., Indigenous Peoples in Canada, individuals living in areas of social isolation or remote areas).^{11,18-20} We acknowledge this as a limitation of our work, and that this Rapid Review may not highlight or identify perspectives and evidence of relevance to these underserved groups. Of note, as part of CDA-AMC's organizational commitment to reconciliation, we know it is important to consider and learn from Indigenous perspectives in our work. We also recognize that the research team consists of settler researchers, and we come to this work with our individual privileges and biases. Understanding the perspectives and priorities of Indigenous Peoples and other underserved groups as they relate to amputations and prostheses can support informed health care decision-making. It is possible that the perspectives and needs of individuals in these groups regarding prostheses and the research related to amputations and prostheses would differ.

Validity of Included Studies

Literature on Microprocessor Knees

For microprocessor knees, the 2 systematic reviews included outcomes with considerable heterogeneity. For example, the systematic reviews included more than 90 different measures of physical function and mobility.^{29,30} Similarly, 1 guideline on lower-limb amputations formed weak recommendations regarding microprocessor knees, supported by weak evidence.³⁵ Using such a variety of outcomes increases the likelihood of finding statistically significant results, affects the ability to pool results, and limits the ability to make definitive conclusions about the clinical effectiveness of microprocessor-enabled prostheses (specifically microprocessor knees) versus body-powered prostheses.

The systematic reviews also focused on transfemoral amputations.^{29,30} These findings may not be generalizable to individuals with amputations at different locations of the lower limbs (e.g., knee or hip disarticulations). One systematic review focused on individuals classified as limited community ambulators, which limited the applicability of their findings to individuals with other mobility levels.²⁹ One systematic review predominantly included studies evaluating specific microprocessor knees (i.e., C-Leg, C-Leg Compact, Genium, and Kenovo) with hydraulic units for comprehensive stance and swing phase.²⁹ It is possible their findings may not be applicable to other microprocessor knees.²⁹ Furthermore, the study sample consisted of mostly males in both systematic reviews.^{29,30} While rates of leg amputations are higher in males in Canada, these findings may not be generalizable to other sexes and genders.

The systematic review of economic evaluations did not include any relevant economic evaluations that were conducted in Canada.³¹ One economic evaluation conducted their analysis from a societal perspective, but remaining evaluations used a payer's perspective.³¹ The economic evaluations also varied in the indirect and direct costs considered in their analysis.³¹ These limitations suggest that the findings of the cost-effectiveness systematic review may not be valid to the public health care systems of Canada. Furthermore, 3 of 4 included economic evaluations evaluated the cost-effectiveness of the C-Leg microprocessor.³¹ It is unclear if these findings are generalizable to all microprocessor knees.

Literature on Myoelectric Prosthesis

All 3 cross-sectional studies were limited in internal validity given the nature of the study designs and interventions.³²⁻³⁴ The literature on upper-limb amputations focused on informing clinical effectiveness in the US veteran population.³²⁻³⁴ The cross-sectional studies had samples composed of mostly white males older than 50 years of age.³²⁻³⁴ It is possible the findings may not be applicable to all people with upper-limb amputations, such as individuals of other races, sexes, genders, or ages.

Gaps in Evidence

We found no literature comparing the cost-effectiveness of myoelectric versus body-powered prostheses for upper-limb amputations. Future studies may wish to address this gap, specifically with a societal perspective in health care systems in Canada.

Evidence on microprocessor-enabled prostheses focused on the knee component of microprocessor-enabled prostheses. None of the clinical effectiveness studies seemed to consider the potential impact of other components of microprocessor-enabled prostheses, such as the socket, shin or pylon, and foot and ankle for transfemoral amputations.¹⁵ The design of the overall prostheses may influence clinical effectiveness in people with lower-limb amputations.¹⁵

Additionally, none of the studies in this Rapid Review investigated the clinical effectiveness or cost-effectiveness of advanced prostheses versus body-powered prostheses in groups of individuals who are typically underserved. As previously mentioned, rates of lower-limb amputations are disproportionately higher in remote areas, areas with lower levels of education, and areas of low social isolation. However, none of the studies for upper-limb amputations reported population characteristics based on socioeconomic status, education, place of residence, or social capital.^{29,30,33,34} The same studies were composed mostly of white

male veterans living in the US.³²⁻³⁴ For question 2, the systematic reviews provided limited details about the study sample demographics.^{29,30} It is unclear if groups of individuals who are typically underserved are represented in the study sample.²⁹

The cross-sectional studies in this Rapid Review described population characteristics, including race.³²⁻³⁴ These studies categorized their study populations into white, Black, or “mixed race/other,” as well as “unknown” or “missing” when the race was not reported in their data.³²⁻³⁴ Individuals classified as “unknown,” “missing,” or “other” may include individuals of diverse races or ethnicities. Of note, individuals categorized as “mixed/other” in included studies are described in this Rapid Review as racialized people. Two studies identified race as a potential confounding variable for the main outcome analysis via statistical methods. One study found Black individuals with upper limb amputations to have significantly lower health-related quality of life specific to mental health (SF-36 mental component summary scores) compared to white individuals with upper-limb amputations.³³ Additionally, Black individuals and racialized people had lower scores for an outcome of function (i.e., Quick Disabilities of Arm, Shoulder, and Hand) compared to white individuals.³³ The other cross-sectional study found that Black individuals had lower device satisfaction scores compared to white individuals.³⁴ Of note, CDA-AMC recognizes that the term “Black” describes a heterogeneous community made up of a diversity of nations, cultures, beliefs, and languages with unique histories and experiences of oppression. However, none of the studies³²⁻³⁴ reported how they defined “Black.”

None of the identified studies or guidelines spoke to the clinical effectiveness, cost-effectiveness, or recommendations regarding the use of advanced prostheses in Indigenous Peoples. Rates of lower-limb amputations are disproportionately higher for Indigenous Peoples in Canada compared to the non-Indigenous population in Canada.¹⁸⁻²⁰ Their experience accessing health care differs from the non-Indigenous populations in Canada due to documented barriers including racism, discrimination, and marginalization within health care systems in Canada.³⁹ Hence, research findings in this Rapid Review may not be generalizable to Indigenous Peoples in Canada.

Conclusions and Implications for Decision- or Policy-Making

This Rapid Review evaluated the literature regarding the clinical effectiveness and cost-effectiveness of myoelectric and microprocessor-enabled prostheses compared to body-powered prostheses for people with amputations. We also evaluated guidelines related to the use of myoelectric and microprocessor-enabled prostheses for upper-body and lower-body amputations, respectively. We identified a total of 9 relevant publications: 3 cross-sectional studies for question 1,³²⁻³⁴ 2 systematic reviews for question 2,^{29,30} 1 systematic review for question 4,³¹ and 3 evidence-based guidelines for question 5.^{6,35,36} We did not identify any relevant literature for question 3 of this Rapid Review.

The evidence summarized in this report was drawn from systematic reviews with some overlap in primary studies, meaning that data from the same participants from 3 of the studies were included in both systematic reviews (refer to Appendix 6 for a citation matrix illustrating the degree of primary study overlap). One included guideline⁶ was informed in part by the 3 cross-sectional studies³²⁻³⁴ included in this Rapid Review to

address research question 1. As a result, some evidence may be disproportionately represented in the overall conclusions. Additionally, 2 cross-sectional studies recruited their study population from the same source and same period.^{33,34} It is possible that these individuals were disproportionately represented in this Rapid Review.

Summary of Evidence

Myoelectric Prosthesis for Upper-Limb Amputations

Overall, the cross-sectional studies suggested that myoelectric prostheses do not provide additional clinical benefits versus body-powered prostheses for adults with upper-limb amputations.³²⁻³⁴ No significant differences, regardless of DOF capabilities, were identified for physical function, quality of life, and satisfaction between myoelectric prosthesis users and body-powered prosthesis users.³²⁻³⁴ However, these cross-sectional studies had limited internal validity by design and methods used and were potentially underpowered (small sample size without power calculations).³²⁻³⁴ Furthermore, these studies included a sample of mostly older, white, male veterans,³²⁻³⁴ with potential overlap of the study population between studies.^{33,34} Therefore, these findings should be interpreted with caution given validity concerns; results may not be applicable to all people with an upper-limb amputation, including equity-deserving groups that are typically underrepresented and underserved.

Furthermore, the guideline from the US Department of Veteran Affairs and Department of Defense suggests that either body-powered or externally-powered prostheses (inclusive of myoelectric devices) be used for patients with upper-limb amputations to improve independence and reduce disability.⁶ This recommendation was graded as “weak for” based on a low certainty of evidence.⁶ The guideline development group assessed the supporting evidence comparing the clinical benefits of myoelectric and body-powered prosthesis to be limited and of low quality.⁶ They did not find sufficient evidence to recommend 1 type of prosthesis over another.⁶

Our conclusion also aligns with the findings of a review published in 2015.⁴⁰ The review found conflicting evidence regarding functional performance and concluded that there is insufficient evidence to recommend myoelectric prostheses over body-powered prostheses for people with upper-limb amputations.⁴⁰

Microprocessor-Enabled Prosthesis for Lower-Limb Amputations

Overall, the literature suggests that microprocessor knees result in better or no additional clinical benefits in safety, physical function or mobility, satisfaction, and quality of life compared to body-powered prostheses for people with transfemoral amputations.^{29,30} These findings align with the published 2009 report by CADTH regarding the clinical and cost-effectiveness of microprocessor knees (C-Leg) for above-the-knee amputations. The CADTH report found that microprocessor knees (C-Leg) improved balance and speed, as well as level and duration of activity.⁴¹ However, the evidence identified to inform this Rapid Review used a wide variety of measures for safety and function, with some outcomes resulting in conflicting results in the literature. For example, the systematic review by Hahn et al.²⁹ identified more than 90 measures involving a variety of tasks used to assess physical function (e.g., walking on uneven terrain, activities of daily living) across included studies. Both systematic reviews found small sample sizes, high attrition rates, and lack of consideration for confounding variables (e.g., training and learning, accommodation time) across included

publications.^{29,30} Some of the authors of 1 systematic review were employees of relevant manufacturers,²⁹ and another review identified that many of their included publications were funded by manufacturers.³⁰ These conflicts of interest may have influenced review conduct. Hence, the findings of these systematic reviews should be interpreted with caution.

The US Department of Veteran Affairs and Department of Defense suggests prescribing microprocessor knees over nonmicroprocessor knees to reduce falls, optimize functional mobility, and improve satisfaction (weak recommendations based on very low certainty evidence).³⁵ The same guideline suggests energy-storing and return or microprocessor-controlled foot and ankle components over solid-ankle, cushioned-heel feet to improve ambulation and patient satisfaction for prosthetic ambulators (based on very low certainty evidence).³⁵ Additionally, they found insufficient evidence to prescribe any specific storing and return or microprocessor foot and ankle component over others (based on very low certainty of evidence).³⁵ The guideline by Stevens and Wurdeman³⁶ recommends that microprocessor knees be indicated over nonmicroprocessor knees to improve safety, walking capabilities and confidence, mobility, satisfaction, well-being, and quality of life, and to alleviate the cognitive burden of ambulation. However, the same guideline did not account for limitations of the evidence, and it also provided no details about the processes to develop the recommendations.³⁶

One systematic review suggested that microprocessor knees were cost-effective compared to body-powered prostheses.³¹ The results reported an ICER range between €3,218 per QALY and €40,155 per QALY.³¹ However, there was considerable heterogeneity across economic evaluations, including time horizon, direct and indirect costs, and threshold of acceptability.³¹ None of the economic evaluations seemed to have considered the costs associated with stopping the use of microprocessor knees in their cost-effectiveness analysis. There is evidence suggesting some people will stop using their prostheses, which remains a concern in the field of prosthetics.^{7,42} In 2013, an investigation of upper-limb prosthesis users in British Columbia found that 20% of people with amputations stopped using their prostheses.⁹ Additionally, none of the economic evaluations were conducted in Canada, and most used a payer's perspective (3 of 4 relevant economic evaluations included in the systematic review).³¹ Most economic evaluations evaluated a specific brand of microprocessor knee (i.e., C-Leg), specifically 3 of 4 relevant evaluations. Hence, it is unclear whether findings are applicable in the health care systems of Canada and to all microprocessor knees.³¹

Considerations for Future Research

Given the research gaps, future endeavours may consider evaluating the clinical effectiveness of advanced prostheses in a more diverse sample with adequate representation of groups of individuals who are typically underrepresented and underserved, including those who are disproportionately impacted, such as populations living in remote areas, in neighbourhoods of low social capital or low socioeconomic status, and Indigenous Peoples living in Canada.

There is evidence to suggest that sex and race may impact clinical outcomes for people with amputations.³³⁻³⁵ This phenomenon requires further investigation, especially within the context of the clinical benefits or harms of advanced prosthesis devices. Currently, the studies that identified race as a confounding variable account for Black, "mixed/other," and white individuals. Additionally, future studies

should ensure comprehensive reporting of their population characteristics to help inform the diversity and applicability of their findings.

Literature on microprocessor-enabled prostheses is limited to microprocessor knees, with no consideration of other components (e.g., sockets or osseointegrated implants, shin, and foot and ankle). Future studies can consider stratifying or adjusting their results by other components of the prostheses to evaluate whether these can influence the benefits of microprocessor knees.

There is some research investigating the potential for artificial intelligence (AI) in prosthetics. AI is being evaluated for its potential to enhance locomotion and control of prostheses.⁴³⁻⁴⁶ Additionally, AI may be leveraged to inform personalized treatment approaches for amputation care rehabilitation, including prosthesis prescription.⁴⁷ However, the use of AI in prosthetics is outside the scope of this report, and requires future exploration.

Additionally, future research can consider evaluating the cost-effectiveness of myoelectric prostheses, as we did not identify any relevant literature published in the past 10 years. In general, cost-effectiveness literature on myoelectric and microprocessor-enabled prostheses may consider use a societal perspective that includes direct (e.g., device, warranty) and indirect costs (e.g., training with prosthetists) to ensure applicability to health systems in Canada. They may also consider the cost implications of stopping prosthesis use. None of the studies in this Rapid Review compared prosthesis abandonment between advanced prostheses and body-powered prostheses. Another Rapid Review found that people may stop using their myoelectric prostheses due to function, weight, lack of durability, difficulty to control, lack of sensory feedback, and slow speed response.⁷ People with upper-limb amputations may stop using their body-powered prostheses due to lack of comfort and function.⁷

Considerations for Decision- or Policy-Making

An exploratory article on prosthesis design concluded that a device's performance may not necessarily depend on design and prescription.⁴⁸ It relies on individual needs, lifestyle, and preferences.⁴⁸ A review suggested that activity-specific prostheses provide a function advantage for upper-limb amputations.⁴⁰ Additionally, the same review found that benefits of myoelectric and body-powered prostheses compared to each other or other alternatives may depend on functional needs, control scheme familiarity, and user preference.⁴⁰ The included evidence-based guidelines also underscored the importance of shared decision-making and patient-centred care in the rehabilitation of amputations.^{6,35}

Health Technology Wales conducted focus groups to identify factors that can influence prosthesis preferences in people with upper-limb amputations.⁷ Some factors that influence prosthesis preference include activities and participation in life situations (e.g., school or work), their self-image with the prosthesis and their desire to fit in, their perceived need of prosthesis, appearance, costs, size, and functionality of the prosthesis.⁷ Some guidelines^{6,35} in this Rapid Review underscore that care should be sensitive to sex, gender, culture, ethnicity, and other dimensions of diversity.^{6,35} The guidelines highlight patient factors (e.g., sex, race) when discussing the literature on interventions or outcomes.^{6,35} The guideline on lower-limb amputation suggests “using patient-identified sex to inform individualized rehabilitation plans.”³⁵ While the

recommendation is considered weak, supporting evidence shows that the benefits of considering sex in the rehabilitation of lower-limb amputations outweigh the potential harms.³⁵

One guideline stated that the process to receive a properly designed and fitting prosthesis can be burdensome, as it involves “patience, frequent visits, and establishment of realistic expectations based on appropriate patient education, and follow-up training.”⁶ A review found that body-powered prostheses require shorter training time, require fewer adjustments, and function with less sensitivity to fit.⁴⁰ Clinicians may wish to consider an individual’s access to services for fitting and training, and willingness to participate, when deciding on an appropriate prosthesis.^{34,40} Travel may be a barrier, especially for patients who live in rural or remote areas with limited access to rehabilitation services.⁴⁹ When clinicians consider these factors, it may help alleviate the likelihood that people will stop using their prostheses. In 2013, a cost-analysis on upper-limb prosthesis for adult workers in Canada suggested that there would be cost-savings of \$305,922 if the appropriate prostheses are initially prescribed.⁹

Indigenous Peoples in Canada disproportionately experience nontraumatic lower-limb amputations from unmet health care needs.¹⁸⁻²⁰ While it is recognized that an amputation is an appropriate option and the safest option in some cases, preventing avoidable nontraumatic lower-limb amputations may be a priority area for Indigenous health.^{36,50,51} Literature suggests that equitable access to Indigenous-focused and culturally appropriate preventive care and chronic disease management services can help prevent avoidable nontraumatic amputations.^{11,50,51}

Clinicians and other decision-makers may use this Rapid Review to inform decision-making regarding advanced prostheses, specifically myoelectric prostheses and microprocessor-enabled prostheses via microprocessor knees. They may wish to consider providing patient-centred care that considers factors such as desired activity levels following amputation, preferences, access to rehabilitation services and prosthesis care, and costs, when providing a prosthesis to people living with amputations.

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Appendix 1: Detailed Methods and Selection of Included Studies

Please note that this appendix has not been copy-edited.

What Is a Rapid Review?

Rapid reviews are based on accelerated and abbreviated systematic review methods, balancing timeliness with rigour, to allow for timely decision-making. Due to these abbreviated methods, rapid reviews have some limitations. For example, we included studies published from 2015, excluding older studies. We attempted to mitigate this by searching for and including relevant systematic reviews published in the past 10 years that included older studies. Focusing on more recently published articles may also be more reflective of current practices.

Literature Search Methods

An information specialist conducted a literature search on key resources including MEDLINE, the Cochrane Database of Systematic Reviews, the International HTA Database, the websites of health technology assessment agencies in Canada and major international HTA agencies, as well as a focused internet search. The search approach was customized to retrieve a limited set of results, balancing comprehensiveness with relevance. The search strategy comprised both controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. Search concepts were developed based on the elements of the research questions and selection criteria. The main search concepts were myoelectric prosthesis, microprocessor-enabled prosthesis, and amputation. The search was completed on July 14, 2025 and limited to English-language documents published since January 1, 2015. The full search strategy is available upon request.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in [Table 1](#). For research questions 1 through 4, we limited study designs of interest to systematic reviews, including those systematic reviews within health technology assessments. When no systematic reviews were available, we included primary studies that met the review's eligibility criteria.

Exclusion Criteria

Articles were excluded if they:

- did not meet the selection criteria outlined in [Table 1](#)
- were duplicate publications or were published before 2015
- were systematic reviews in which all relevant studies were captured in other more recent or more comprehensive systematic reviews

- were systematic reviews without a research question, a reproducible search strategy, selection criteria, screening methods, critical appraisal or risk of bias assessment, or information about data analysis and synthesis that allows for reproducibility²⁸
- were primary studies captured in 1 or more included systematic reviews
- were guidelines with unclear methodology
- were studies that evaluated the difference in kinetic or biomechanic outcomes between advanced prosthesis types and body-powered prostheses
- were health technology assessments with abbreviated systematic review methods

Critical Appraisal of Individual Studies

The included publications were critically appraised 1 reviewer using the following tools as a guide: A MeaSurement Tool to Assess systematic Reviews 2 (AMSTAR 2)⁵² for systematic reviews and the Downs and Black checklist⁵³ for randomized and nonrandomized studies. For guidelines, the included publications were critically appraised by 1 reviewer using Appraisal of Guidelines for Research and Evaluation (AGREE) II instrument.⁵⁴ Summary scores were not calculated for the included studies; rather, the strengths and limitations of each included publication were described narratively.

Data Extraction

One reviewer extracted data directly into standardized tables created in Microsoft Word, which were modified as necessary. The extracted information included study characteristics, methodology (e.g., study design), population, intervention, comparator, and results regarding the outcomes of interest.

One reviewer extracted information from the included systematic reviews and primary studies using the PROGRESS-Plus tool⁵⁵ to describe different population groups. Each included study was checked to determine if PROGRESS-Plus⁵⁵ criteria were reported by study authors to describe the participants; detailed characteristics, if available, were then extracted and reported in tables in [Appendix 3](#). The main PROGRESS-Plus⁵⁵ criteria include place of residence; race, ethnicity, culture, and/or language; occupation; gender and/or sex; religion; education; socioeconomic status; and social capital. As part of report writing, we discuss these characteristics across the evidence, where available, when presenting results within the text.

When reporting on sex, gender, race, or ethnicity in this Rapid Review, we planned to retain the language used by the original study authors, and, whenever possible, we referred to these groups based on guidance from *Canada's Drug Agency Style: A Guide for Authors and Editors*⁵⁶ at the time this Rapid Review was conducted, with an understanding that language is constantly evolving.

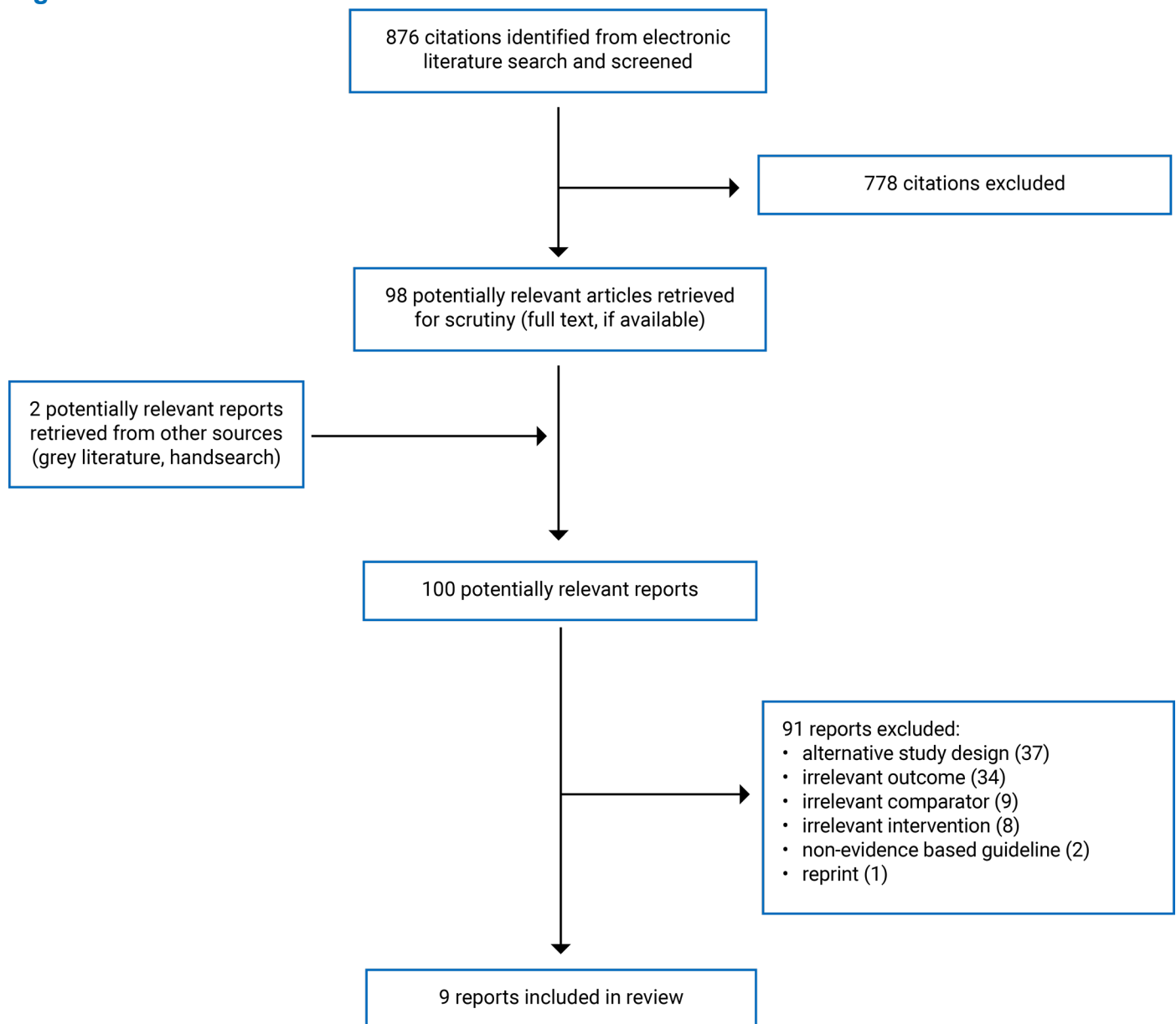
Patient Engagement

By understanding the needs of the requestor, internal capacity, and timeliness associated with this Rapid Review, we did not conduct any patient engagement with people living with an upper- or lower-body amputation to inform this work. We acknowledge this as a limitation of our report.

Appendix 2: Selection of Included Studies

Please note that this appendix has not been copy-edited.

Figure 1: Selection of Included Studies



Appendix 3: Characteristics of Included Publications

Table 2: Characteristics of Nonrandomized Studies for Question 1

Study citation, country, funding source	Study design	Population characteristics	Relevant Interventions and comparators	Clinical outcomes
Question 1: Clinical effectiveness of myoelectric prosthesis				
Resnik et al. (2022) ³² Country: US Funding source: Orthotics and Prosthetics Outcomes Research Program, Prosthetics Outcomes Research Award	Cross-sectional, observational study	People with unilateral and bilateral upper limb amputations recruited across 5 US sites. N = 127 Unilateral amputation: 112 (88.2%) Amputation type (unilateral only) • Transradial: 75 (66.9%) • Transhumeral: 32 (28.6%) • Shoulder disarticulation and interscapulothoracic: 5 (4.5%) Age, mean (SD) = 56.9 (16.5) years Gender, males: 123 (96.9%)^a Gender, females: 4 (3.2%)^a Race White: 95 (74.8%) Black: 12 (11.0%) Mixed/other: 18 (14.2%) Ethnicity Hispanic: 16 (12.6%) Not Hispanic: 107 (84.3%) Unknown: 4 (3.2%) Military Status Veterans: 108 (85.0%) Active duty: 2 (1.6%) Civilians: 17 (13.4%) Etiology of Amputation	Interventions: • Single-DOF myoelectric prostheses including electronic terminal devices such as Greifers, and sensor speed hands (21% of participants) • Multi-DOF myoelectric prostheses including I-limb, Michelangelo, bebionic, and LUKE hands (20% of study participants) Comparator: Body-powered prosthesis (59% of study participants) Note: Researchers classified all hybrid devices as myoelectric	Outcomes: • Physical function and mobility via measures of: ◦ Dexterity (Jebsen-Taylor Hand Function, 9 hole peg, box and block, Southampton hand assessment procedure;) ◦ Disability (DASH) ◦ Activity performance (e.g., brief activities for upper limb amputation, timed measure of activity performance; need for activity of daily living help) • Health-Related quality of life via (i.e., Veterans RAND 12 item health survey mental composite score and physical composite score) • Satisfaction (i.e., Trinity Amputation and Prosthesis Experience Satisfaction) • Social health (community reintegration of injured service members-computer adapted-test)

Study citation, country, funding source	Study design	Population characteristics	Relevant Interventions and comparators	Clinical outcomes
		Congenital: 4 (8.9%) Combat: 38 (35.9%) Accident: 58 (54.7%) Burn: 10 (9.4%) Cancer: 5 (4.7%) Diabetes: 1 (0.9%) Infection: 15 (14.2%) Prosthesis Training A quarter of the study population received prosthesis training for their device. Other PROGRESS-Plus Criteria SES: NR Place of residence: NR Education: NR Religion: NR Social Capital: NR		
Resnik et al. (2020) ³³ Country: US Funding source: Orthotics Research Program, Prosthetics Outcome Research Award	Cross-sectional survey	Veterans with unilateral upper limb amputation who received care in the Veterans Affairs between 2010 and 2015. N = 755 ^b Users of prostheses relevant to this report: 427 (56.5%) Age Body-powered, mean (SD) = 65.8 (12.4) years Myoelectric prostheses (single-DOF), mean (SD) = 58.7 (15.9) years Myoelectric prostheses (multi-degrees of freedom), mean (SD) =	Intervention: • Single degree of freedom myoelectric prostheses including electronic, hook, terminal devices such as Greifers, and sensor speed hands (n = 62) • Multi-DOF myoelectric prostheses including I-limb, Michelangelo, bebionic, and LUKE hands (n = 40) Comparators: Body-powered prosthesis (n = 325)	Outcomes: Physical Function via measures of • Disability (i.e., DASH) • Activity performance (Help with activities of daily living) Quality of Life • Veterans RAND 12-Item Health Survey (Physical and mental component)

Study citation, country, funding source	Study design	Population characteristics	Relevant Interventions and comparators	Clinical outcomes
		63.9 (10.4) years Sex, male: 422 (98.8%)^a Sex, female: 21 (2.8%)^a Time since initial amputation Body-powered prostheses, mean (SD) = 36.6 (17.4) years Myoelectric prostheses (single degree of freedom), mean (SD) = 25.7 (18.4) years Myoelectric prosthesis (multi-degrees of freedom), mean (SD) = 32.8 (17.8) years Race White: 328 (76.8%) Black: 42 (9.8%) Other, including mixed race: 19 (4.5%) Missing: 38 (8.9%) Ethnicity (Hispanic or Latino) Yes: 35 (8.2%) No: 373 (87.4%) Missing: 19 (4.4%) Etiology of Amputation^c: Combat injury: 190 (44.5%) Accident: 268 (62.8%) Burn: 45 (10.5%) Cancer: 7 (1.6%) Diabetes: 3 (0.7%) Infection: 41 (9.6%) Amputation of dominant side: Yes: 227 (53.2%) No: 198 (46.4%)		

Study citation, country, funding source	Study design	Population characteristics	Relevant Interventions and comparators	Clinical outcomes
		Missing: 2 (0.4%) Amputation level: Forequarter: 8 (1.9%) At the shoulder joint: 15 (3.5%) Above the elbow: 95 (22.2%) At the elbow: 19 (4.5%) Below the elbow: 197 (46.1%) At the wrist joint: 93 (21.8%) Prosthesis training Yes: 329 (77.1%) No: 95 (22.2%) Missing: 3 (0.7%) Other PROGRESS-Plus Criteria SES: NR Place of residence: NR Education: NR		
Resnik et al. (2020) ³⁴ Country: US Funding source: US army medical research acquisition activity	Cross-sectional survey	Veterans with major upper limb amputation who received any type of medical care from the Veterans Affairs between 2010 and 2015. N = 449^b Users of prostheses relevant to this report: 427 (95.1%) Age Body-powered prostheses, mean (SD) = 65.5 (12.7) years Myoelectric or hybrid prostheses, mean (SD) = 55.7 (15.4) years Gender , male: 422 (98.8%) ^a Gender , female: 8 (1.8%) ^a Time since initial amputation Body-powered prostheses, mean	Intervention: Myoelectric prostheses including hybrid devices (n = 93) Comparator: Body-powered prosthesis (n = 334)	Outcomes: Satisfaction (i.e., Modified Trinity Amputation and Prosthesis Experience Scales – Satisfaction Scale; Orthotics and Prosthetics Users' Survey Client Satisfaction with devices Scale)

Study citation, country, funding source	Study design	Population characteristics	Relevant Interventions and comparators	Clinical outcomes
		(SD) = 36.3 (17.6) years Myoelectric or hybrid prostheses, mean (SD) = 23.5 (17.1) years Race White: 328 (76.8%) Black: 42 (9.8%) Other, including mixed race: 19 (4.5%) Unknown: 38 (8.9%) Ethnicity (Hispanic or Latino) Yes: 35 (8.2%) No: 373 (87.3%) Unknown: 19 (4.5%) Amputation level Forequarter: 8 (1.9%) At the shoulder joint: 15 (3.5%) Above the elbow: 95 (22.2%) At the elbow: 19 (4.5%) Below the elbow: 197 (46.1%) At the wrist joint: 93 (21.8%) Etiology of Amputation^c Combat injury: 190 (44.5%) Accident: 268 (62.8%) Burn: 45 (10.5%) Cancer: 7 (1.6%) Diabetes: 3 (0.7%) Infection: 41 (9.6%) Other PROGRESS-Plus Criteria SES: NR Place of residence: NR Education: NR		

Study citation, country, funding source	Study design	Population characteristics	Relevant interventions and comparators	Clinical outcomes
		Religion: NR Social Capital: NR		

DASH = disabilities of the arm, shoulder, and hand; DOF = degree of freedom; NR = not reported; RAND = research and development; SD = standard deviation; SES = socioeconomic status.

Note: This table has not been copy-edited.

Note: PROGRESS-Plus⁵⁵ guided data extraction for population characteristics of primary studies included in this current review. DOF describes the terminal device of myoelectric prostheses.

^aThe study did not define or differentiate between sex and gender.

^bValue reported encompasses study participants not relevant to this report (i.e., nonusers or cosmetic devices).

^cStudy participants can be included in more than 1 category.

Table 3: Characteristics of Included Systematic Reviews

Study citation, countries of eligible studies, funding source	Study designs, included studies, and search strategy	Population characteristics	Intervention and comparator(s)	Relevant outcomes, length of follow-up
Question 2: Clinical effectiveness of microprocessor-enabled prosthesis				
Hahn et al. (2022) ²⁹ Country: Authors did not report on the location of included primary studies. Funding source: None reported.	Study design: Systematic review with meta-analysis. Number of included studies: 15, including 13 NRS and 2 crossover RCT. (All are relevant to this current review) Search strategy: Electronic database search in MEDLINE, Cochrane Library, CINAHL Complete, Embase, Google Scholar, as well as Databases DARE, Cirié, PEDro, and OTseeker with the search term logic adapted to their search.	People with transfemoral or amputations above the knee with a mobility grade equivalent to MCFL-2 or low mobility. N = 704 Sex, male (n): 542 (76.9%) Sex, female (n): 161 (22.9%) Age: Mean age ranged from 57.1 to 69 years across included studies. Etiology: Vascular disease: 255 Trauma: 202 Other: 225 Other PROGRESS-Plus criteria: NR; Review authors did not report on population characteristics by gender, SES, race or ethnicity, education, place of residence	Intervention: Microprocessor knees (e.g., C-Leg, C-Leg compact, Genium, K) Comparator: Nonmicroprocessor knees	Outcomes: • Safety (e.g., fall, stumbles, fear of falling) • Function or performance (e.g., walking speed, Montreal rehabilitation Performance Profile, MCFL change) • Satisfaction (e.g., Prosthesis Evaluation Questionnaire, satisfaction) Follow-up: ranges from 1 week to 6 months Outcomes included in meta-analysis: • Safety (i.e., number of falls, fear of falling, Timed up and go test) • Function and mobility (i.e., Positive mobility grade change, walking speed, fast walking speed)

Study citation, countries of eligible studies, funding source	Study designs, included studies, and search strategy	Population characteristics	Intervention and comparator(s)	Relevant outcomes, length of follow-up
		(urban, rural, or remote), religion. It is unclear if primary studies reported these characteristics for their sample.		Satisfaction (i.e., General Prostheses Evaluation Questionnaire)
Thibaut et al. (2022)³⁰ Country: Authors did not report on the location of included primary studies. Funding source: Author's salary partially paid by Fonds Neurologic and Functional Rehabilitation Center	Study design: Systematic review. Number of included studies: 18, including 3 crossover RCTs and 12 NRS (17 studies are relevant to this review). Literature search strategy: Electronic database search on MEDLINE, Scopus, and SPORTDiscus for relevant publications from 1946 to February 15, 2021. They also conducted a manual search of bibliographies in relevant papers.	People with unilateral transfemoral limb loss N (range) = 993 (20 to 602). Age: mean age ranged from 38.5 to 69 years across included studies Sex and gender^b, male (%) = 766 (77.1%) Sex and gender^b, female: NR Etiology of limb loss: Review authors reported by study. The review includes people with vascular disease (including diabetes), arterial disease, tumours, infection, nonvascular diabetes, congenital limb loss. Other PROGRESS-Plus criteria: NR; Review authors did not report on population characteristics, such as SES, race or ethnicity, education, place of residence, religion, occupation and education. It is unclear if primary studies reported these characteristics for their sample.	Intervention: Microprocessor knees Comparator: Nonmicroprocessor knees	Outcome: - Mobility (e.g., ambulation, timed up and go, Locomotor Capabilities Index, 6 minute walk test) - Quality of life (e.g., 36-item short form health survey) Follow-up: 1 week to 6 months
Question 4: Cost-effectiveness of microprocessor-enabled prosthesis				
Donnelley et al. (2021)³¹ Denmark, Italy, Sweden, and the US	Study design: Systematic review of economic evaluations. Number of included	People with upper- or lower-extremity amputation using a prosthesis (the 4 relevant economic evaluations were conducted)	Intervention: Prosthesis-related devices, inclusive of microprocessor knees Comparison: Other prosthesis--	Outcomes: ICER Analysis type: cost-utility Perspective: payer (3 studies), societal (1 study)

Study citation, countries of eligible studies, funding source	Study designs, included studies, and search strategy	Population characteristics	Intervention and comparator(s)	Relevant outcomes, length of follow-up
Funding source: Not reported.	studies: 12 economic evaluations (4 are relevant to this current review) Literature search strategy: Electronic database search of PubMed, Embase, and Web of Science search engines for economic evaluations published before May 2, 2019.	considering people with a transfemoral amputation). n , relevant studies ^c = Approximately 273 Other PROGRESS-Plus criteria: NR; Review authors did not report on population characteristics, such as age, sex, gender, SES, race or ethnicity, education, place of residence, religion, occupation, and education. It is unclear if included economic evaluations reported these characteristics for their sample.	related devices, inclusive of nonmicroprocessor knees.	Time Horizon: ranges between 5 to 10 years across relevant included economic evaluations.

CINAHL = Cumulative Index to Nursing and Allied Health Literature; Embase = Excerpta Medica Database; DARE = Database of Abstracts of Review of Effects; ICER = incremental cost-effectiveness ratio; PEDro = Physiotherapy Evidence Database; MCFL-2 = Medicare functional classification level 2; NA = not applicable; NR = not reported; NRS = nonrandomized studies; OT = occupational therapy; SES = socioeconomic status.

Note: This table has not been copy-edited.

Note: PROGRESS-Plus⁵⁵ guided data extraction of systematic reviews included in this current review. We acknowledge that sex is assigned at birth and based on genetics, whereas gender refers to an individual's social experience of being a man, woman, trans, or identifying outside gender confines. None of the studies defined how researchers identified sex or gender.

^aMedicare functional classification level 2 means the individual was assessed with the ability or potential for ambulation with ability to traverse low level environmental barriers (e.g., curbs, stairs, uneven surfaces), which is typical of a "limited community ambulator."³⁸

^bThe systematic review by Thibault et al.³⁰ did not differentiate between sex and gender. It is unclear whether included studies in the systematic review defined or differentiated these terms.

^cAn included economic evaluation included in the systematic review by Donnelley et al.³¹ did not disclose the total number of their sample population.

Table 4: Characteristics of Included Guidelines for Question 5

Intended users, target population	Intervention and practice considered	Major outcomes considered	Evidence collection, synthesis, and quality assessment	Recommendations development and evaluation	Guideline validation
Department of Veterans Affairs and the Department of Defense (2024)³⁵					
Intended users: Veterans Affairs or Department of Defense, community providers, and others involved in the health care team caring for adults with	An evidence-based framework for evaluating and managing the target population. Prosthetic interventions	Short, intermediate, and long-term clinical benefits and harms of relevant interventions (e.g., functional status, quality of	A systematic search conducted in multiple electronic databases for English-only systematic reviews and clinical studies published from July 6,	The Lower-Limb Amputation Work Group developed recommendations informed by the systematic review.	The Lower-Limb Amputation Work Group internally reviewed the first 2 drafts. Experts identified from

Intended users, target population	Intervention and practice considered	Major outcomes considered	Evidence collection, synthesis, and quality assessment	Recommendations development and evaluation	Guideline validation
lower-limb amputation. Target population: Adults (ages 18+) who have had a lower-limb amputation, including those receiving care within the Veterans Affairs and Department of Defense health care delivery systems in the US.	(e.g., microprocessor knees, rehabilitation interventions, surgical interventions, and behavioural health or psychosocial interventions).	life, satisfaction and falls), when available.	2016 to March 15, 2024. The results of the relevant studies were summarized qualitatively. A focus group was created through a convenience sample and consisted of 9 participants who received care from the Veterans Affairs and/or the Department of Defense for their amputation care or rehabilitation. The focus group was conducted to understand patient's perspectives on their treatment and overall care to inform guideline development. The risk of bias of primary studies was assessed using the US Preventive Services Task Force method.	They determined the strength and direction of each recommendation by assessing the quality of the overall evidence base, the associated benefits and harms, patient values and preferences, and other implications. The strength of the recommendation was determined by the GRADE approach.	Veterans Affairs and Department of Defense health care systems reviewed the draft. The lower-limb Amputation Work Group presented the guidelines to the Veterans Affairs and Department of Defense Evidence-Based Practice Work Group for approval.
Department of Veterans Affairs and the Department of Defense (2022)⁶					
Intended users: Health care providers caring for patients with an upper limb amputation, specifically rehabilitation care providers like physicians, therapists, and prosthetists. Target population:	Evidence-based practices on the target population. Prevention and treatment of phantom and residual limb pain, clinical assessments and outcome tools, psychosocial interventions, surgical procedures and	Short, intermediate, and long-term clinical benefits and harms of rehabilitation strategies (e.g., functional status, independence, pain, mental health, and satisfaction), when available.	A systematic evidence review with a search involving multiple electronic databases of English-only systematic reviews and clinical studies published between February 1, 2013, and April 30, 2021. The results of relevant literature were	The Management of Upper Limb Amputation Rehabilitation Work Group (46 members) developed recommendations informed by the systematic review. They determined the strength and direction of	The Management of the Upper Limb Amputation Work Group internally reviewed the first 2 drafts of the guidelines. Experts identified from Veterans Affairs and Department of Affairs were invited to provide feedback

Intended users, target population	Intervention and practice considered	Major outcomes considered	Evidence collection, synthesis, and quality assessment	Recommendations development and evaluation	Guideline validation
Adults with an upper limb amputation, including veterans, service members, military retirees, and beneficiaries.	medical interventions, and rehabilitation and prosthetic interventions.		qualitatively summarized. A focus group was created through a convenience sample and consisted of 9 participants, 6 of which were veterans who received care from Veterans Affairs and 4 were service members who received care from the Department of Defense. The focus group was conducted to understand patient's perspectives on their treatment and overall care to inform guideline development. The risk of bias of relevant primary studies was assessed using the US Preventive Services Task Force method.	each recommendation by assessing the quality of the overall evidence, the associated benefits and harms, patient values and preferences, and other implications. The strength of the evidence was determined by the GRADE approach.	for the Work Group to consider The Management of the Upper Limb Amputation Work Group presented the guidelines to the Veterans Affairs and Department of Defense Evidence-Based Practice Work Group for approval.
Stevens and Wurdeman (2019)³⁶					
Intended users: Prosthetists, referring surgeons and physicians, treating physical therapists, and policy-makers. Target population: Adults with unilateral lower-limb absence whether congenital or acquired	Present the highest level of evidence on prosthetic knee joint selection. Specifically, microprocessor-regulated knees were compared to nonmicroprocessor-regulated knees. Microprocessor knees in this guideline are specific to swing and stance	The outcomes considered were comparative effectiveness, and the benefits and harms of treatments.	A systematic literature search involving 1 electronic database of systematic reviews, meta-analyses, and published prescription guidelines published up to April 2017. Evidence statements or supported narrative statements were extracted from relevant literature.	Beyond being informed with a systematic review, the guideline did not provide additional details about recommendation development. Recommendations were not evaluated and lacked level of certainty or a grade.	The guidelines do not report any validation of recommendations.

Intended users, target population	Intervention and practice considered	Major outcomes considered	Evidence collection, synthesis, and quality assessment	Recommendations development and evaluation	Guideline validation
because of dysvascular, traumatic, or other etiology.			The quality and certainty of the evidence used to inform recommendations was not assessed.		

GRADE = Grading of Recommendations Assessment, Development and Evaluation.

Note: This table has not been copy-edited.

Appendix 4: Critical Appraisal of Included Publications

Please note that this appendix has not been copy-edited.

Table 5: Clinical Effectiveness of Myoelectric Prosthesis for Question 1: Strengths and Limitations of Cross-Sectional Studies Using the Downs and Black Checklist⁵³

Strengths	Limitations
Resnik et al. (2022)³²	
Researchers clearly described the objective of the study. They also clearly described the interventions of interest and main outcomes, including how measures should be interpreted. Researchers provided a satisfactory description of study population demographics (e.g., gender, race, ethnicity, employment status, military status, etiology of amputation, training) and characteristics of prosthesis used (i.e., terminal device type). Additionally, they described demographics and prosthesis type by amputation type, specifically unilateral and bilateral amputations. No individuals lost to follow-up based on study design (i.e., cross-sectional design). All study participants were recruited from the same population. Researchers reported simple outcome data, estimates of random variability, and actual P values, when appropriate. The researchers used appropriate statistical tests to assess the main outcomes. The main outcome measures seem valid and reliable. Researchers conducted Benjamin-Hochberg method to adjust for false discovery rates from multiple comparisons. Researchers declared the source of funding and declared no conflict of interests.	The study did not measure adverse events from the interventions. Researchers used a convenience sample to recruit individuals for this study. The researchers described the distribution of potential confounders in the study population (e.g., age, training for prosthesis, terminal device type). However, they did not evaluate the differences in distribution between study groups, nor did they adjust for confounding variables (e.g., experience with prosthesis use and training) The recruitment strategy used a convenience sample without details regarding the period of recruitment. Hence, the study population may not be representative of the entire population from which the researchers recruited from. The study sample was mostly men. It is likely that the study sample is not representative of the entire population of interest. The staff, places, and facilities may not be representative of most of the population of interest may receive. The study recruited individuals from 6 US sites, which are not described. It is unclear how the findings apply to health settings and population of interest located in Canada. The research design (i.e., cross-sectional) and intervention limits the potential to randomize participants into study arms. Additionally, the nature of the study design and intervention limits the ability to conceal treatment from researchers and study participants involved in the study. Researchers did not calculate whether the study had sufficient power to detect a statistically significant effect. The study had a small sample size (n = 127).
Resnik et al. (2020)³³	
Researchers clearly described the objective of the study. They also clearly described the interventions of interest and main outcomes. Researchers published literature to describe the development and pilot testing of the survey instrument. Researchers provided a satisfactory description of study population demographics (e.g., sex, race, ethnicity, employment status, etiology of amputation, training) All study participants were recruited from the same population during the same period.	The study did not measure adverse events from the interventions. It is unclear whether study participants are representative of the population from which researchers recruited from. Researchers did not describe individuals that opted out from participating in the study. It is unclear how they may have impacted findings. Researchers recruited the study population mostly of male (> 90%) US veterans. It is likely that this study population does not reflect the entire population of interest. Additionally, researchers used a sampling frame consisting of veterans receiving care from US Veterans Affairs. It is unclear how applicable these findings are to health settings in Canada, and if

Strengths	Limitations
Researchers reported estimates of random variability, and actual P values, when appropriate. The researchers used appropriate statistical tests to assess the main outcomes. The main outcome measures seem valid and reliable. It seems that researchers did not conduct any unplanned analysis. No individuals lost to follow-up based on study design (i.e., cross-sectional design). Researchers reported no conflicts of interest and disclosed funding sources. Researchers conducted a bivariate linear regression to identify potential confounders. They adjusted for identified confounders ($P < 0.10$) in their regression analysis for main outcomes.	the staff, places, and facilities are representative of the population of interest experience when seeking care. The research design (i.e., cross-sectional) and intervention limits the potential to randomize participants into study arms. Additionally, the nature of study design and intervention limits the ability conceal the intervention from researchers and study participants involved in the study. Researchers did not provide details on how they addressed missing data. It is unclear how these may have impacted findings. The study lacks statistical analysis to adjust for multiplicity (there are multiple outcomes investigating function). Researchers suspect that the study may have been under powered to detect differences by certain prosthesis configuration subgroups due to their small size. Individuals with missing data on terminal devices were categorized as single-DOF myoelectric prostheses. It is unclear how the misclassification may have impacted findings. Overlap of study population with a cross-sectional study³⁴ funded by US army included in this report is unclear.
Resnik et al. (2020) ³⁴	
Researchers clearly described the objective of the study. They also clearly described the interventions of interest and main outcomes. Researchers provided a satisfactory description of study population demographics (e.g., gender, race, ethnicity, employment status, etiology of amputation, training). Researchers conducted general linear regression models to identify confounders ($P < 0.20$) for consideration in their analysis of main outcomes. Researchers reported estimates of random variability, and actual P values, when appropriate. All study participants were recruited from the same population during the same period. Researchers reported estimates of random variability, and actual P values, when appropriate. The researchers used appropriate statistical tests to assess the main outcomes. It seems that the main outcome measures used in the study were valid and reliable. It seems that researchers did not conduct any unplanned analysis. No individuals lost to follow-up based on study design (i.e., cross-sectional design). Researchers declared funding source and no conflicts of interest.	The study did not measure adverse events from the interventions. The research design (i.e., cross-sectional) and intervention limits the potential to randomize participants into study arms. Additionally, the nature of the study design and intervention limits ability to conceal the intervention from researchers and study participants involved in the study. It is unclear whether study participants are representative of the population from researchers recruited from. Researchers did not describe individuals that opted out from participating in the study. It is unclear how they may have impacted the findings. Researchers recruited the study population mostly of older male (> 90%) US veterans. It is likely that this study population does not reflect the entire population of interest. It is unclear how applicable these findings are to health settings in Canada, and if the staff, places, and facilities are representative of the experience seeking care for the population of interest. Researchers did not conduct any investigations to confirm that sufficient power to detect a clinically important effect. Researchers excluded missing data from analysis. It is unclear how these may have impacted findings. The study lacks statistical analysis to adjust for multiplicity (multiple outcomes for satisfaction). Overlap of study population with a cross-sectional study³⁴ funded by US army included in this report is unclear.

DOF = degree of freedom.

Note: We acknowledge that sex is assigned on birth and based on genetics, whereas gender refers to an individual's social experience of being a man, women, trans, or identifying outside gender confines. None of the studies defined these terms in this Rapid Review.

Table 6: Clinical Effectiveness of Microprocessor Knees vs. Nonmicroprocessor Knees for Question 2: Strengths and Limitations of Systematic Reviews and Meta-Analyses Using AMSTAR 2⁵²

Strengths	Limitations
Hahn et al. (2022)²⁹	
The systematic review authors clearly defined their research questions and selection criteria. The systematic review authors provided satisfactory details regarding their literature search strategy. They also searched reference lists for relevant publications. Two systematic reviewers performed screening and critical appraisal in duplicate. The systematic review authors described the population, intervention, comparators, outcomes, research designs, time frame for follow-up, and results in adequate detail. The systematic review authors conducted a risk of bias assessment for included primary studies (i.e., State of the Science Evidence Report Guidelines). No funding was associated with the work featured in the systematic review. The meta-analysis included suitable parameters when it was identified in at least 3 independent studies. They reported the results of primary studies included in the review separately, including outcomes they were unable to include in the meta-analysis. The review authors used an appropriate weighted technique to combine study results. The systematic review authors presented the results of fixed and random effects models. Their justification was that the random-effects model accounts for different patient characteristics between the studies.	The publication lacks an explicit statement about established methods before the conduct of the systematic review or meta-analysis. The review authors conducted a preparatory systematic literature search with no details about the process. The systematic review authors did not justify their inclusion of both randomized controlled trials and nonrandomized studies. It is unclear if data extraction was performed in duplicate. It seems that the tool used to assess risk of bias lacked consideration of confounding variables (e.g., hip amputations, bilateral vs. unilateral amputations) The systematic review authors were unable to explore the possibility of publication bias due to relatively small number of studies that were pooled for the same outcome for the meta-analysis. The systematic review authors acknowledged that the small number of studies pooled for each outcome in the meta-analysis limited exploration of heterogeneity. Hence, it is unclear how sources of heterogeneity may have impacted effect sizes in the meta-analysis. Some systematic review authors were employees of the manufacturers of microprocessor knees during study conduct. The systematic review authors did not attempt to stratify for hip as an amputation or for bilateral amputations (potential confounders) in their meta-analysis The systematic review authors did not report specific values for nonsignificant results. External validity of the results to all microprocessor knees is unclear. The systematic review authors did not report where primary studies were conducted. The review authors did not provide a satisfactory discussion of the implications of the risk of bias in primary studies included in the systematic review. The systematic review did not report whether included studies described or provided information on dimensions of difference or diversity, such as ethnicity, race, place of residence, and gender. It is unclear how generalizable these results are to equity-deserving populations.
Thibaut et al. (2022)³⁰	
The systematic review authors clearly defined their research questions and selection criteria. The systematic review has an explicit statement of established methods with information about its registration. The systematic review authors described each study's	The systematic review authors did not justify their inclusion of both nonrandomized or randomized controlled trials, nor did they justify the inclusion of non-English and non-French publications and exclusion of studies with < 20 participants. The systematic review authors did not state their search time

Strengths	Limitations
population, intervention, comparators, outcomes, research design, and time frame for follow-up. PRISMA table listed excluded studies with rationale. The systematic review authors provided satisfactory details regarding the funding and conflicts of interest as reported by each included study. The systematic review authors use a satisfactory technique to assess the risk of bias in individual studies, specifically Cochrane Risk of Bias tool for randomized controlled trials and NIH study quality assessment tools for NRS. No conflicts of interest declared by systematic review authors. Systematic reviews provided a satisfactory discussion about the risk of bias, specifically its impact on the internal validity of the report.	frame for their search strategy. The systematic review authors did not report quantitative results reported by included studies, including P values. It is unclear if risk of bias assessment was conducted in duplicate. It is unclear if any of the studies extracted data on people living in Canada or conducted in a health setting in Canada. Manufacturers of microprocessor knees funded some of the primary studies included in the systematic review. For 1 study, a manufacturer provided microprocessor knees, training sessions for ortho-prosthetists and rehabilitation knees, and support to monitor the multicentric study. The systematic review did not report whether included studies described or provided information on dimensions of difference or diversity, such as ethnicity, race, place of residence, and gender. It is unclear how generalizable these results are to equity-deserving populations. Most included studies had a small sample size. Except for a few cross-sectional studies, most studies had a sample size of 20.
Donnelley et al. (2021) ³¹	
The objective and exclusion criteria are clearly defined. The systematic review authors used a comprehensive literature search strategy. The systematic review authors conducted screening, and data extraction in duplicate. The systematic review provided detailed description of the intervention, comparators, and research designs of included economic evaluations. It seems that the systematic review authors used a satisfactory technique to assess risk of bias of included economic evaluations (i.e., Quality of Health Economic Studies instrument). The risk of bias instrument includes assessment of sources of funding for included studies. Overall health utility values (self-reported) were used to conduct economic evaluations. The review authors reported no conflicts of interest.	The systematic review authors did not explicitly include a statement that review methods were established prior the conduct of the review. Additionally, they did not clearly define the inclusion criteria, nor did they justify the inclusion of the types of economic evaluation. The systematic review authors did not provide a satisfactory list of excluded studies from full-text review. It is unclear if risk of bias assessment was conducted in duplicate. The systematic review authors did not provide a satisfactory detail about the population included in the relevant studies to this report (e.g., age, sex or gender, etiology of amputation). The systematic review authors also did not provide details regarding the type of model used by included economic evaluations. The systematic review authors did not discuss the impact of the risk of bias assessment on the findings of included economic evaluations. It is unclear if these studies are applicable to health settings as Canada, because of the following: • included economic evaluations relevant to this current review were conducted in other countries (e.g., Italy, US) • most included economic evaluations (3 of 4) relevant to this current review were conducted with a payer perspective. • Direct and indirect costs considered differed across relevant economic evaluations. These costs may not align with the costs incurred from a societal perspective in Canada's public health care system.

Strengths	Limitations
	• Varying acceptable threshold across economic evaluations. It is possible that these thresholds may not align with available resources allocated for prosthesis use in Canada's health care system. • time horizons differ across studies (ranges from 1 to 10 years for relevant economic evaluations) Replacement intervals for devices vary across jurisdictions in Canada. A time horizon of 1 year may not provide enough insights on costs.²³ Most studies do not consider indirect costs associated with the natural history or progression of diseases, such as rehabilitation costs (e.g., physical therapist). It is unclear whether economic evaluations included in this review considered costs when adults have transitioned from mechanical knees to microprocessor knees (in such cases, costs should consider initial mechanical knees and costs from microprocessor knees). Included economic evaluations used general self-reported measures of overall health. However, relative clinical measures that provide in-depth investigation of function and mobility are outcomes of interest for clinical effectiveness. The systematic review authors did not disclose the source of funding for this study.

AMSTAR 2 = A Measurement Tool to Assess systematic Reviews 2; NIH = National Institute of Health; NRS = nonrandomized study; vs. = versus.

Table 7: Strengths and Limitations of Guidelines Using AGREE II⁵⁴

Item	Department of Veterans Affairs and the Department of Defense (2024) ³⁵	Department of Veterans Affairs and the Department of Defense (2022) ⁶	Stevens and Wurdeman (2019) ³⁶
Domain 1: Scope and purpose			
1. The overall objective(s) of the guideline is (are) specifically described.	Yes	Yes	Yes
2. The health question(s) covered by the guideline is (are) specifically described.	Yes	Yes	Yes
3. The population (patients, public, and so on) to whom the guideline is meant to apply is specifically described.	Yes	Yes	Yes
Domain 2: Stakeholder involvement [wording from original source]^a			
4. The guideline development group includes individuals from all relevant professional groups.	Yes	Yes	No
5. The views and preferences of the target population (patients, public, and so on) have been sought.	Yes	Yes	No
6. The target users of the guideline are clearly defined.	Yes	Yes	Yes
Domain 3: Rigour of development			
7. Systematic methods were used to search for evidence.	Yes	Yes	Yes

Item	Department of Veterans Affairs and the Department of Defense (2024) ³⁵	Department of Veterans Affairs and the Department of Defense (2022) ⁶	Stevens and Wurdeman (2019) ³⁶
8. The criteria for selecting the evidence are clearly described.	Yes	Yes	No
9. The strengths and limitations of the body of evidence are clearly described.	Yes	Yes	No
10. The methods for formulating the recommendations are clearly described.	No	No	No
11. The health benefits, side effects, and risks have been considered in formulating the recommendations.	Yes	Yes	Yes
12. There is an explicit link between the recommendations and the supporting evidence.	Yes	Yes	Yes
13. The guideline has been externally reviewed by experts before its publication.	Yes	Yes	No
14. A procedure for updating the guideline is provided.	Yes	Yes	No
Domain 4: Clarity of presentation			
15. The recommendations are specific and unambiguous.	Yes	Yes	Yes
16. The different options for management of the condition or health issue are clearly presented.	Yes	Yes	Yes
17. Key recommendations are easily identifiable.	Yes	Yes	Yes
Domain 5: Applicability			
18. The guideline describes facilitators and barriers to its application.	Yes	Yes	No
19. The guideline provides advice and/or tools on how the recommendations can be put into practice.	Yes	Yes	No
20. The potential resource implications of applying the recommendations have been considered.	Yes	Yes	No
21. The guideline presents monitoring and/or auditing criteria.	Yes	Yes	No
Domain 6: Editorial independence			
22. The views of the funding body have not influenced the content of the guideline.	Yes	Yes	Yes
23. Competing interests of guideline development group members have been recorded and addressed.	Unclear	Unclear	No

AGREE II = Appraisal of Guidelines for Research and Evaluation II.

^aWe retained the domain names that are included in the original AGREE II checklist, which includes the term “stakeholder” (i.e., in domain 2), to be clear that we assessed the strengths and limitations of guidelines using AGREE II. However, Canada’s Drug Agency understands that language is constantly evolving and the word “stakeholder” has an association with colonialism; whenever possible, Canada’s Drug Agency does not use this word in our reports.

Appendix 5: Main Study Findings

Table 8: Clinical Effectiveness of Body-Powered vs. Myoelectric (With Single-DOF or Multi-DOF Terminal Devices) by Amputation Type for Question 1 From Resnik et al. (2022)³²

Outcome, amputation	Transradial, mean (SD)				Transhumeral, mean (SD)			
	Body-powered	Myoelectric, single	Myoelectric multi	P value	Body-powered	Myoelectric single	Myoelectric multi	P value
Physical function and mobility								
Jebsen-Taylor Hand Function (dexterity) ^a , combined ^b								
Writing	0.56 (0.33)	0.47 (0.27)	0.53 (0.29)	0.53	0.38 (0.35)	0.23 (0.20)	0.25 (0.17)	0.62
Page turning	0.17 (0.13)	0.15 (0.09)	0.12 (0.07)	0.29	0.07(0.06)	0.04 (0.07)	0.04 (0.04)	0.24
Small objects	0.13 (0.11)	0.12 (0.12)	0.08 (0.09)	0.02	0.07 (0.06)	0.03 (0.06)	0.02 (0.02)	0.01
Eating	0.19 (0.11)	0.17 (0.13)	0.13 (0.09)	0.13	0.09 (0.09)	0.07 (0.08)	0.04 (0.04)	0.45
Checkers	0.09 (0.08)	0.13 (0.14)	0.12 (0.08)	0.29	0.07 (0.07)	0.05 (0.07)	0.03 (0.03)	0.73
Light cans	0.25 (0.19)	0.23 (0.12)	0.27 (0.15)	0.68	0.14 (0.11)	0.09 (0.10)	0.11 (0.05)	0.36
Heavy cans	0.25 (0.22)	0.27 (0.12)	0.25 (0.13)	0.24	0.09 (0.10)	0.09 (0.10)	0.15 (0.08)	0.24
Box and blocks	20.6 (9.2)	15.1 (9.1)	15.4 (6.0)	0.02^c	11.8 (9.8)	5.2 (5.7)	7.6 (6.5)	0.22
9 hole peg	0.07 (0.06)	0.06 (0.06)	0.01 (0.01)	0.0001^c	0.05 (0.06)	0.01 (0.03)	0 (0)	0.03
Southampton Hand Assessment Procedure	44.0 (19.6)	41.0 (21.1)	39.6 (14.8)	0.57	14.4 (15.3)	10.8 (16.6)	12.8 (12.7)	0.67
Jebsen-Taylor Hand Function (dexterity) ^a , unilateral amputation								
Writing	0.49 (0.30)	0.41 (0.26)	0.52 (0.30)	0.43	0.29 (0.26)	0.21 (0.20)	0.25 (0.17)	0.83
Page turning	0.13 (0.09)	0.14 (0.10)	0.12 (0.07)	0.82	0.06 (0.05)	0.02 (0.03)	0.04 (0.04)	0.15
Small objects	0.11 (0.07)	0.11 (0.11)	0.07 (0.09)	0.03	0.07 (0.06)	0.01 (0.02)	0.02 (0.02)	0.005^c
Eating	0.18 (0.12)	0.17 (0.14)	0.14 (0.09)	0.42	0.08 (0.09)	0.05 (0.06)	0.04 (0.04)	0.55

Outcome, amputation	Transradial, mean (SD)				Transhumeral, mean (SD)			
	Body-powered	Myoelectric, single	Myoelectric multi	P value	Body-powered	Myoelectric single	Myoelectric multi	P value
Checkers	0.08 (0.06)	0.08 (0.09)	0.12 (0.08)	0.1	0.06 (0.07)	0.03 (0.05)	0.03 (0.03)	0.6
Light cans	0.20 (0.13)	0.22 (0.11)	0.28 (0.15)	0.3	0.12 (0.09)	0.06 (0.07)	0.11 (0.05)	0.23
Heavy cans	0.20 (0.17)	0.26 (0.12)	0.25 (0.14)	0.048	0.08 (0.11)	0.08 (0.09)	0.15 (0.08)	0.15
Box and blocks	19.00 (8.73)	14.27 (7.88)	15.28 (6.19)	0.06	10.5 (9.34)	4.00 (4.47)	7.60 (6.50)	0.22
9 hole peg	0.06 (0.05)	0.06 (0.06)	0.01 (0.01)	0.0008^c	0.04 (0.04)	0 (0)	0 (0)	0.02^c
Southampton Hand Assessment Procedure	42.4 (18.4)	39.3 (23.1)	40.2 (15.0)	0.83	13.4 (16.2)	6.6 (10.3)	12.8 (12.7)	0.54
Activities Measure for Upper Limb Amputation (activity), ^a unilateral	14.9 (5.3)	14.9 (7.7)	16.4 (6.5)	0.68	12.3 (6.2)	9.4 (4.2)	11.9 (1.8)	0.23
Brief Activities Measure for Upper Limb Amputation (activity), ^a unilateral	6.6 (2.1)	9.2 (1.0)	9.2 (1.0)	0.0023^c	4.5 (3.4)	4.0 (NR)	3.5 (0.7)	0.83
Timed Measure of Activity Performance (activity), ^d unilateral	5.0 (1.8) mins	3.9 (0.6) mins	3.9 (0.9) mins	0.08	4.6 (1.7) mins	4.9 (1.2) mins	7.4 (3.0) mins	0.18
Need for activities of daily living Health (n [yes], %) ^e unilateral	7 (21.2)	3 (37.5)	2 (16.7)	0.57	3 (25.0)	2 (28.6)	2 (28.6)	1.0000
QuickDASH (disability), unilateral	29.2 (19.4)	30.9 (15.8)	26.3 (18.1)	0.7196	34.0 (20.7)	28.2 (13.8)	30.5 (13.3)	0.85
Quality of life								
Veterans RAND 12 item Mental Composite score (HRQoL) ^a unilateral	53.5 (10.1)	46.3 (12.8)	52.4 (11.5)	0.0854	50.4 (13.1)	50.6 (14.6)	52.9 (9.4)	0.98

Outcome, amputation	Transradial, mean (SD)				Transhumeral, mean (SD)			
	Body-powered	Myoelectric, single	Myoelectric multi	P value	Body-powered	Myoelectric single	Myoelectric multi	P value
Veterans RAND 12 item Physical Composite score (HRQoL), ^a unilateral	37.5 (8.9)	43.2 (6.9)	41.1 (8.2)	0.09	34.7 (13.2)	41.9 (5.6)	44.0 (8.1)	0.17
Social Health								
CRISCAT (extent of participation in community), ^a unilateral	50.1 (8.7)	44.6 (9.6)	49.5 (8.8)	0.24	45.4 (8.3)	50.1 (10.9)	53.2 (8.6)	0.13
CRISCAT (Perceived difficulty in participation), ^a unilateral	49.4 (6.8)	44.3 (4.7)	51.1 (9.1)	0.03	46.2 (5.0)	48.3 (7.1)	48.8 (7.9)	0.87
Satisfaction								
CRISCAT (satisfaction), ^a unilateral	51.2 (9.2)	46.9 (7.7)	50.2 (10.5)	0.37	45.6 (4.9)	47.9 (5.8)	47.7 (7.9)	0.55
Trinity Amputation and Prosthesis Experience Satisfaction Scale (satisfaction), ^a unilateral	4.0 (0.7)	3.5 (0.7)	3.8 (0.7)	0.051	3.7 (0.9)	3.5 (0.5)	3.7 (0.5)	0.64

CRISCAT = Community Reintegration of Injured Service Members-Computer Adapted-Test; DASH = disabilities of the arm, shoulder, and hand; DOF = degree of freedom; HRQoL = health-related quality of life; SD = standard deviation; vs. = versus.

Note: This table has not been copy-edited.

Note: Bolded P values denote statistical significance ($P < 0.05$).

^aHigher scores indicate a better result.³²

^bCombined results include people with unilateral and bilateral amputations. Results for bilateral amputations consider the dominant side only.³²

^cFindings remain significant after Benjamin-Hochberg adjustment with false discovery rate = 0.1.

^dLower scores indicate a better result.³²

^eParticipants responded yes or no. Individuals that respond “No” means that they do not require help and signifies greater independence.³²

Table 9: Clinical Effectiveness of Body-Powered and Cosmetic Devices vs. Myoelectric (With Single-DOF or Multi-DOF Terminal Devices) for Question 1

Relevant outcome by study	Body-powered	Myoelectric, single-DOF ^c	P value	Myoelectric, multi-DOF	P value
Resnik et al. (2020), ³³ unilateral amputations					
Veteran's RAND 12-item Health Survey, mental component summary (Beta, 95% CI)	reference	2.07 (−1.73 to 5.87)	0.29	2.59 (−2.14 to 7.32)	0.28
Veteran's RAND 12-item Health Survey, physical component summary (Beta, 95% CI)	reference	0.17 (−2.26 to 2.59)	0.89	−0.97 (−3.99 to 2.05)	0.53
Quick DASH (Beta, 95% CI) ^b	reference	−1.72 (−7.58 to 4.14)	0.56	1.24 (−5.88 to 8.36)	0.73
Help with activities of daily living	reference	0.55 (0.24 to 1.23)	0.14	1.75 (0.81 to 3.79)	0.15
Resnik et al. (2020), ³⁴ combined ^{a,b}					
Trinity Amputation and Prosthesis Experience Scales Satisfaction (beta) ^a	reference	−0.08 ^a	0.33 ^a	NA	NA
Orthotics and Prosthetics Users' Survey – Client Satisfaction with Devices Scale (beta) ^a	reference	1.19 ^a	0.59 ^a	NA	NA

CI = confidence interval; DASH = disabilities of the arm, shoulder, and hand; DOF = degree of freedom; NA = not applicable; RAND = research and development; SD = standard deviation; vs. = versus.

Note: This table has not been copy-edited.

Note: Results for cosmetic devices are only included in cases where it impacts P values. Resnik et al. (2020)³⁴ did not separate results by DOF of terminal devices for myoelectric prostheses.

^aThe study by Resnik et al.³⁴ compared satisfaction between myoelectric (regardless of the DOF of terminal devices) and body-powered devices. Hence, the results under the "Myoelectric, single-DOF" column for Resnik et al. (2020)³⁴ includes all myoelectric or hybrid devices.

^bResults includes individuals with bilateral and unilateral amputations.

Table 10: Meta-Analysis by Hahn et al. (2022)²⁹ – Clinical Effectiveness of Microprocessor vs. Nonmicroprocessor Knees for Question 2

Outcome	Microprocessor knees, total	Non-microprocessor knees, total	Standardized mean difference (95% CI)	P value	I ²
Safety					
Number of falls	—	—	—	—	0%
Fixed effect model	117	114	−0.59 (−0.85 to −0.21)	< 0.01	NA
Random-effects model	NA	NA	−0.59 (−0.85 to −0.21)	< 0.01	NA
Fear of falling	—	—	—	—	80%
Fixed effect model	464	464	1.75 (1.60 to 1.90)	< 0.01	NA

Outcome	Microprocessor knees, total	Non-microprocessor knees, total	Standardized mean difference (95% CI)	P value	I ²
Random-effects model	NA	NA	1.20 (0.55 to 1.85)	< 0.01	NA
Timed up and go	—	—	—	—	0%
Fixed effect model	45	45	-0.45 (-0.87 to 0.02)	0.04	NA
Random-effects model	NA	NA	-0.45 (-0.87 to 0.02)	0.04	NA
Function, performance, and mobility					
Positive mobility grade change ^a	—	—	—	—	16%
Fixed effect model	519	NA	0.51 (0.47 to 0.55)	NA	NA
Random-effects model	NA	NA	0.51 (0.47 to 0.55)	NA	NA
Walking speed	—	—	—	—	0%
Fixed effect model	71	71	0.47 (-1.81 to 1.42)	< 0.01	NA
Random-effects model	NA	NA	0.47 (-1.81 to 1.42)	< 0.01	NA
Fast walking speed	—	—	—	—	0%
Fixed effect model	22	22	0.40 (-0.21 to 1.01)	0.20	NA
Random-effects model	NA	NA	0.40 (-0.21 to 1.01)	0.20	NA
Activity-specific Balance Confidence Scale	—	—	—	—	48%
Fixed effect model	40	40	7.90 (0.34 to 15.46)	0.04	NA
Random-effects model	NA	NA	7.55 (-7.03 to 22.14)	0.31	NA
Perception and experience					
Ambulation	—	—	—	—	7%
Fixed effect model	78	78	9.24 (3.77 to 14.70)	< 0.01	NA
Random-effects model	NA	NA	9.32 (3.61 to 15.03)	< 0.01	NA
Appearance	—	—	—	—	1%
Fixed effect model	68	68	5.24 (-0.85 to 11.32)	0.09	NA
Random-effects model	NA	NA	5.24 (-0.85 to 11.35)	0.13	NA
Residual limb	—	—	—	—	4%
Fixed effect model	69	69	4.45(-1.15 to 10.05)	0.12	NA
Random-effects model	NA	NA	4.43 (-1.29 to 10.14)	0.13	NA
Sounds	—	—	—	—	0%
Fixed effect model	69	69	3.36 (-4.65 to 11.37)	0.41	NA
Random-effects model	NA	NA	3.36 (-4.65 to 11.37)	0.41	NA
Utility	—	—	—	—	0%
Fixed effect model	69	69	7.76 (2.05 to 13.47)	< 0.01	NA

Outcome	Microprocessor knees, total	Non-microprocessor knees, total	Standardized mean difference (95% CI)	P value	I ²
Random-effects model	NA	NA	7.76 (2.05 to 13.47)	< 0.01	NA
Well-being	—	—	—	—	0%
Fixed effect model	68	68	4.97 (−1.01 to 10.96)	0.10	NA
Random-effects model	NA	NA	4.97 (−1.01 to 10.96)	0.10	NA

NA = not applicable; vs. = versus.

Note: This table has not been copy-edited.

Note: This table details the results of a meta-analysis of patient reported outcomes by Hahn et al. (2022).²⁹

^aPositive grade change from changing to a microprocessor knee from nonmicroprocessor knee.

Table 11: Clinical Effectiveness of Microprocessor Knees vs. Nonmicroprocessor Knees for Question 2

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
General prosthesis use					
Questionnaire for Persons with Transfemoral Amputation	NA	NA	NA	One cross-sectional study found no difference between microprocessor knees and nonmicroprocessor knees.	NR
Safety					
Perception of safety on stops	7.8	10.3%	0.005	NA	NA
Perception on safety on sidesteps	10.3	14.2%	0.002	NA	NA
Perception on stability on stops	10.8	14.7%	< 0.001	NA	NA
Perception on stability on side steps	7.6	10%	0.007	NA	NA
Perception on Obstacle clearance	13.3	18.9%	0.001	NA	NA
Number of nonstumpers	NR	42%	0.044	NA	NA
Number of stumbles ^a	NR	NR	ns	NA	NA
	−6	−76%	0.21	NA	NA
Number of falls	NA	NA	NA	One crossover randomized study found no difference between microprocessor and nonmicroprocessor knees.	NR

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
				Two before-and-after studies found a reduction in falls after changing to a microprocessor knee from a nonmicroprocessor knee.	
Number of semicontrolled falls	NR	NR	ns	NA	NA
Number of nonfallers	NR	NR	ns	NA	NA
Fear of stumbles	11.6	15.7%	0.05	NA	NA
Observed fall events	NR	NR	ns	NA	NA
Improved perception of safety ^{a,b}	85% (95% CI, 84 to 90)	NA	NR	NA	NA
	100% (95% CI, 91.2 to 100)	NA	NR	NA	NA
Function, performance, or mobility					
SSWS heel rise with the prosthetic limb	NR	NR	0.33	NA	NA
FPWS heel rise with the prosthetic limb	NR	NR	0.019	NA	NA
Activity-specific Balance Confidence Scale ^a	15.6	26%	< 0.001	NA	NA
	-41.1	-118.7%	0.09	NA	NA
	NR	NR	ns	NA	NA
Perceived improvements in standing ^b	69% (95% CI, 46 to 92)	NA	NR	NA	NA
SWSS level walking - Cadence	7.0	9.2%	0.001	NA	NA
SWSS level Walking – Stride Length	0.1 m	11.9%	0.003	NA	NA
FPWS level walking - Cadence	8.8 m	10.1%	0.002	NA	NA
FPWS level walking – Stride length	0.13 m	13.6%	< 0.001	NA	NA
SSWS level walking – Single Limb Support	NR	NR	0.048	NA	NA

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
Perceived improvement in level walking ^b	79% (95%, CI 42 to 86)	NA	NR	NA	NA
FPWS single limb support (prosthetic side)	NR	NR	ns	NA	NA
FPWS (uneven terrain)	0.14 m/s	25.2%	0.01	NA	NA
Confidence while walking	NR	NR	ns	NA	NA
2 minute walk test ^a	16.84 m	18.1%	0.001	NA	NA
	NR	NR	ns	NA	NA
6 minute walk test	NR	NR	ns	One before-and-after study observed a decrease in time after changing to a microprocessor knees from nonmicroprocessor knees. A cross-sectional study found no difference between groups.	NR
10 minute walk test	-2.6 second	14.4%	0.045	NA	NA
Speed 10-minute walk test	0.1 m/s	15.2%	0.009	NA	NA
Perceived improvement in level walking ^b	64% (95% CI, 42 to 86)	NA	NR	NA	NA
Confidence while walking	NR	NR	ns	NA	NA
Improved ability to walk backward ^b	75.0% (95% CI, 58.7 to 91.3)	NA	NR	NA	NA
Improved ability to do small steps ^b	65.0% (95% CI, 47.0 to 83.0)	NA	NR	NA	NA
Stair mobility ^a	-5.7	172.7%	0.01	NA	NA
	NR	NR	ns	NA	NA
Improved stair ambulation ^b	41.3% (95% CI, 22.8 to 60)	NA	NR	NA	NA
Improved descend on ramps ^b	86.8% (95% CI, 74.0 to 99.6)	NA	NR	NA	NA
Hill mobility	-2.1	38.9%	0.01	One before-and-after study found higher hill assessment index scores for microprocessor knees	NR

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
				vs. nonmicroprocessor knees.	
Hill speed	-0.46 m/s	27.1%	0.002	NA	NA
Speed in Slope Ascend	0.13 m/s	27.7%	0.01	NA	NA
Cadence in Slope Ascend	9.7	14.3%	0.01	NA	NA
Stride Length in Slope Ascend	0.10 m	11.9%	0.02	NA	NA
Speed in Slope Descend	0.14 m	36.2%	< 0.001	NA	NA
Cadence in Slope Descend	10.9	16%	< 0.02	NA	NA
Stride length in Slope Descend	0.13 m	13.7%	0.003	NA	NA
Obstacle course	-0.09 m/s	11.3%	0.02	NA	NA
Improved symmetry ^b	95.5% (95% CI, 89.6 to 100)	NA	NR	NA	NA
Improved relief sound side ^b	89.3% (95% CI, 77.6 to 100)	NA	NR	NA	NA
	95% (95% CI, 93 to 97)	NA	NR	NA	NA
Multitasking	-15.0	21.1%	0.04	NA	NA
Activity level	NA	NA	NA	One before-and-after study observed higher activity levels with microprocessor knees vs. nonmicroprocessor knees	NR
Activity time	4%	20%	0.02	NA	NA
Sitting time	9%	17%	0.01	One before-and-after study found that there is less sitting time for microprocessor knees vs. nonmicroprocessor knees.	NR
Activity avoidance (VAS)	NR	NR	ns	NA	NA
Attention accuracy (VAS)	NR	NR	ns	NA	NA
Improved attention ^{a,b}	89.7% (95% CI, 78.2 to 100)	NA	NR	NA	NA

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
	90% (95% CI, 87 to 93)	NA	NR	NA	NA
Improved variability in speed ^b	78.6%; (95% CI, 63.1 to 94.1)	NA	NR	NA	NA
Improved gait harmonization ^b	93% (95% CI, 90 to 95)	NA	NR	NA	NA
Improved level walking ^b	79% (95% CI, 42 to 86)	NA	NR	NA	NA
Improved – uneven ground	64% (95% CI, 42 to 85)	NA	NR	NA	NA
Improved variability in gait speed ^b	92.6%; (95% CI, 82.7 to 100)	NA	NR	NA	NA
	86% (95% CI, 83 to 89)	NA	NR	NA	NA
Improved overall effort ^b	84% (95% CI, 81 to 87)	NA	NR	NA	NA
	85.7% (95% CI, 72.5 to 98.9)	NA	NR	NA	NA
Improved perceived exertion ^b	84% (95% CI, 67 to 100)	NA	NR	NA	NA
Improved ability to overcome obstacles ^b	84.0% (95% CI, 70.2 to 97.8)	NA	NR	NA	NA
Improved ramps ^b	86.8% (95% CI, 74 to 99.6)	NA	NR	NA	NA
Improved ability to carry heavy loads ^b	78.2% (95% CI, 62.6 to 93.8)	NA	NR	NA	NA
Improved ability to carry with visual obstruction ^b	88.0% (95% CI, 75.7 to 100)	NA	NR	NA	NA
Improved results for the “door test” ^b	92.3% (95% CI 82.6 to 100)	NA	NR	NA	NA
Improved mobility on standing ramps ^b	92.0% (95% CI, 81.8 to 100)	NA	NR	NA	NA
Improved toileting ^b	56.0% (95% CI, 37.3 to 74.7)	NA	NR	NA	NA
Mental energy expenditure	NR	NR	ns	NA	NA
Difficulty with concentration	NR	NR	ns	NA	NA

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
Improved concentration ^b	79% (95% CI, 61 to 97)	NA	NR	NA	NA
Stair Ambulation ^b	88.9% (95% CI, 77.0 to 100)	NA	NR	NA	NA
Ambulation (PEQ)	1.6	25.4%	0.04	NA	NA
ADAPT circuit	NA	NA	NA	One randomized crossover study found that the time to complete ADAPT was shorter for “intermediate” and “high subgroups.”	NR
ADAPT perceived difficulty (C-Leg compact)	NR	NR	ns	NA	NA
ADAPT, low activity level	NR	NR	ns	One randomized crossover study found no difference between microprocessor and nonmicroprocessor knee.	NR
ADAPT, AS1 (C-Leg)	NR	NR	0.0001	NA	NA
ADAPT, AS1 (C-Leg compact)	NR	NR	0.002	NA	NA
ADAPT, AS1 high activity level (C-Leg)	NR	NR	0.01	NA	NA
ADAPT, AS1 high activity level (C-Leg Compact)	NR	NR	0.019	NA	NA
ADAPT, AS1 intermediate activity level (C-Leg)	NR	NR	0.004	NA	NA
ADAPT, AS1 intermediate activity level (C-Leg Compact)	NR	NR	0.008	NA	NA
ADAPT, AS2 intermediate activity level ^a	NR	NR	ns	NA	NA
ADAPT, AS2 intermediate activity level (C-Leg)	NR	NR	0.0016	NA	NA
ADAPT, AS2 high activity level	NR	NR	ns	NA	NA

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
ADAPT, perceived difficulty for AS2	NR	NR	0.023	NA	NA
ADAPT AS3 intermediate activity level	NR	NR	ns	NA	NA
ADAPT, AS3 high activity level	NR	NR	0.023	NA	NA
ADAPT, AS3 high activity level (C-Leg)	NR	NR	ns	NA	NA
ADAPT, perceived difficulty for AS3 (C-Leg)	NR	NR	0.0008	NA	NA
ADAPT, SAI intermediate activity level (C-Leg)	5.5	171.9%	< 0.025	NA	NA
ADAPT, SAI high activity level(C-Leg)	5.3	147.2%	< 0.025	NA	NA
ADAPT, SAI low activity level	NR	NR	ns	NA	NA
ADAPT, SAI intermediate activity level (C-Leg Compact)	4.6	143.8%	< 0.025	NA	NA
ADAPT, SAI high activity level (C-Leg Compact)	5.2	144.4%	< 0.025	NA	NA
Wheelchair dependence	NR	43%	0.005	NA	NA
Locomotor Capabilities Index ^a	2.4	5.6%	0.02	One randomized crossover study found improvement was observed in the microprocessor vs. nonmicroprocessor group. Two before-and-after studies found an improvement in scores after changing to microprocessor from nonmicroprocessor knees	NR
	NR	NR	ns	NA	NA
	NR	NR	ns	NA	NA

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
Prosthetic limb users survey of mobility ^a	4.67	10.6%	0.004	One study found mobility was greater for microprocessor knees compared to nonmicroprocessor knees.	NR
	NR	NR	ns	NA	NA
Amputee Mobility predictor ^a	3.49	9.6%	< 0.001	NA	NA
	NR	NR	ns	NA	NA
The 4 square step test	NR	NR	ns	NA	NA
L-test of functional mobility	-8.01 second	-21.1%	< 0.001	NA	NA
Montreal Rehabilitation Performance Profile	2.7	38.8%	0.03	NA	NA
Mobility grade change	NR	NR	ns	NA	NA
Distance (10 m walk test)	NA	NA	NA	One cross-sectional study found no difference between microprocessor knees and nonmicroprocessor knees.	NR
General Self-Efficacy Scale	NA	NA	NA	One cross-sectional study found no difference between microprocessor knees and nonmicroprocessor knees.	NR
Timed up and go	6.8s	38.4%	< 0.02	One randomized crossover study found that the microprocessor group had a shorter time vs. the nonmicroprocessor group.	NR
Houghton's Scale ^a	NR	NR	0.058	NA	NA
	2.75	100%	0.19	NA	NA
	NR	NR	ns	NA	NA
	NR	NR	ns	NA	NA
Berg Balance Scale ^a	-2.25	-7.3	0.56	NA	NA
	NR	NR	ns	NA	NA
	NR	NR	ns	NA	NA

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
Satisfaction					
Satisfaction with walking (high activity level) ^a	10.6	15%	0.04	NA	NA
Satisfaction with walking, (intermediate activity level)	28.1	49.8%	0.007	NA	NA
Preference ^b	89% for microprocessors	NA	NA	NA	NA
Satisfaction with prosthesis	NR	NR	ns	NA	NA
Satisfaction (VAS)	NR	NR	Ns	NA	NA
Quebec User Evaluation of Satisfaction with Assistive Technology	0.8	17%	0.001	NA	NA
Frustration (PEQ)	NR	NR	ns	NA	NA
Perceived response (PEQ)	NR	NR	ns	NA	NA
Social burden (PEQ)	NR	NR	ns	NA	NA
Orthotics Prosthetics User Survey	NR	NR	ns	NA	NA
Quality of Life					
SF-36	NR	NR	ns	One crossover randomized study and 1 before-and-after study found better SF-36 scores with microprocessor knees.	NR
SF-36 vitality	NA	NA	NA	One before-and-after study found no improvement from changing to microprocessor from nonmicroprocessor knees.	NR
SF-36 general health	NA	NA	NA	One before-and-after study found no improvement from changing to microprocessor from nonmicroprocessor knees	NR

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
SF-36 social role	NA	NA	NA	One before-and-after study found no improvement from changing to microprocessor from nonmicroprocessor knees.	NR
SF-36 emotional role	NA	NA	NA	One before-and-after study found no improvement from changing to microprocessor from nonmicroprocessor knees.	NR
SF-36 pain	NA	NA	NA	One before-and-after study found no improvement from changing to microprocessor from nonmicroprocessor knees.	NR
SF-36 mental component summary	3.86	7.4%	0.04	One before-and-after study found no improvement from changing to microprocessor from nonmicroprocessor knees.	NR
SF-36 physical component summary	NR	NR	ns	One before-and-after study found an improvement in scores after changing to microprocessor knees from nonmicroprocessor knees. Another before-and-after study found no difference in scores.	NR
EQ-5D-5L	0.08	12.1	0.01	One cross-sectional study found higher scores for microprocessor knees (C-Leg) compared to nonmicroprocessor knees	NR
Other					
Frustration with falls	NR	NR	ns	NA	NA
Embarrassment with falls	NR	NR	Ns	NA	NA
Gait Analysis					

Outcome	Hahn (2022), ²⁹ Systematic Review			Thibaut (2022), ³⁰ Systematic Review	
	Absolute difference	Relative difference	P value	Results	P value
Gait speed	NA	NA	NA	One cross-sectional study found faster gait speed with microprocessor knees compared to nonmicroprocessor knees.	NR
Stride length	NA	NA	NA	One cross-sectional study found no difference between microprocessor knees and nonmicroprocessor knees.	
Knee extension and latency period	NA	NA	NA	One cross-sectional study found no difference between microprocessor knees and nonmicroprocessor knees.	NR
Knee latency	NA	NA	NA	One cross-sectional study found no difference between microprocessor knees and nonmicroprocessor knees.	NR
Stance phase duration	NA	NA	NA	One cross-sectional study found no difference between microprocessor knees and nonmicroprocessor knees.	NR
3D Gait analysis	NR	NR	ns	NA	NA
Gait, entropy	NA	NA	NA	One before-and-after study found no improvement from changing to microprocessor from nonmicroprocessor knees	NR
Gait profile score	NR	NR	ns	NA	NA
Electromyography signals (various)	NR	NR	ns	NA	NA

ADAPT = Assessment of Daily Activity Performance in Transfemoral Amputees Test; AS = activity set; FPWS = fastest possible walking speed; NA = not applicable; NR = not reported; ns = not statistically significant; SAI = stair assessment index; SPSS = self-selected walking speed; VAS = visual analogue scale; vs. = versus.

Note: This table has not been copy-edited.

Note: Bolded results denotes statistical significance. Outcomes from the systematic review by Hahn et al.²⁹ were only included in this table if review authors were unable to include the results in meta-analysis. The systematic review by Thibaut et al.³⁰ used descriptive statistics only and did not report any quantitative results of included primary studies. Additionally, the systematic review by Thibaut et al.³⁰ did not report statistical significance for most outcomes, nor did they define how they decided on how to report favourable or unfavourable qualitative findings.

Note: A primary study included in the systematic review by Hahn et al.²⁹ recruited a small number of participants with high heterogeneity. The primary study researchers used descriptive analysis only. The primary study's result favours microprocessor knees over nonmicroprocessor knees, specifically for timed up and go, 2 minute walk test, self-selected walking speed, fastest possible walked speed, berg balance scale, mobility grade scale, observed fall events, Houghton's scale, Orthotics Prosthetics Users Survey, Locomotors Capabilities Index, Activities-Specific Balanced Confidence Scale, 36-Item Short Form Survey, and 3D gait analysis.

^aResults available for the outcome measure in more than 1 included study in the systematic review by Hahn et al.²⁹ current report.

^bThe systematic review by Hahn et al.²⁹ reported these results are presented by % of improved participants instead of absolute or relative difference between the effect of microprocessor knees and nonmicroprocessor knees.

Table 12: Economic Evaluations Included in the Systematic Review by Donnelley et al. (2021)³¹

Included study	Perspective	Time horizon (years)	Effect measure	Total costs	Utility	ICER	Discount rate	Acceptability threshold
Brodtkobt TH, et al. <i>Arch Phys Med Rehabil.</i> 2008;89:24 to 30. ^a	Payer	8	EQ VAS	Micro-processor knee: €25,146 Mechanical knee: €17448	Micro-processor knee: 6.98 Mechanical knee: 3.60	€3,218 per QALY	3%	€10,000 per QALY
Chen C, et al. <i>J Neuroeng Rehabil.</i> 2018;15 (Suppl 1):62.	Societal	10	SF-36, PEQ, EQ-5D	Micro-processor knee: US\$15,083/year Mechanical knee: US\$13,382	Micro-processor knee to mechanical knee: 0.91	US\$11,606 per QALY	3%	US\$50,000 to US\$150,000 per QALY
Cutti AG, et al. <i>Prosthet Orthot. Int</i> 2017;41:227 to 36. ^a	Payer	5	EQ-5D	Micro-processor knee: €22,656 Mechanical knee: €4,144	Micro-processor knee: 3.84 Mechanical knee: 3.38	€40,155 per QALY	None	€54,120 per QALY
Gerzeli S, et al. <i>Eur J Heal Econ.</i> 2009;10:47 to 55 ^a	Payer	5	EQ-5D	Micro-processor knee: €22,744 Mechanical knee: €7,449	Micro-processor knee: 3.55 Mechanical knee: 3.14	€35,971 per QALY	3%	€30,000 to €100,000 per QALY

EQ VAS = EQ visual analogue scale; ICER = incremental cost-effectiveness ratio; PEQ = Prosthesis evaluation questionnaire; QALY = Quality-adjusted life-year SF-36 = 36-Item Short Form Survey.

Note: This table has not been copy-edited.

Note: Bolded rows indicate cost-effectiveness based on the acceptability threshold. All included economic evaluations conducted a univariate sensitivity analysis and costs associated with transfemoral amputations. Included studies that did not use a relevant study design (e.g., budget impact analysis) were excluded from this table.

^aIntervention is specific to the C-Leg microprocessor knee.

Table 13: Summary of Recommendations in Included Guidelines

Recommendations and supporting evidence	Quality of evidence and strength of recommendations
Department of Veterans Affairs and the Department of Defense (2024)³⁵	
“For prosthetic ambulators, we suggest prescribing microprocessor knee units over non-microprocessor knee units for reducing falls, optimizing functional mobility, and improving patient satisfaction.” (p. 31) Supporting evidence: Four studies found that microprocessor knees are favoured for motor and physical function in the stair assessment index, hill assessment index, locomotor capability index, and motor tests over a 1 to 3-month follow-up period as compared to nonmicroprocessor knees. In addition, 2 studies found that microprocessor knees were favoured over nonmicroprocessor knees for locomotor ability in longer term follow-up (6 months). In terms of specific microprocessor knees, 1 large study found no difference in the Prosthetic Limb Users Survey of Mobility scores between the C-Leg, Rheo, Orion, and Plie microprocessor knees.	Quality of evidence: Very low certainty of evidence Strength of recommendation: Weak for
“For prosthetic ambulators, there is insufficient evidence to prescribe any specific energy storing and return (ESAR) or microprocessor foot and ankle component over another.” (p. 31) Supporting evidence: There was evidence to support the prescription of ESAR prosthetic feet or microprocessor-controlled foot and ankle components over solid ankle cushion heel, but there was no evidence to suggest which specific option was better than the other.	Quality of evidence: Very low certainty of evidence Strength of recommendation: Neither for nor against
“For prosthetic ambulators, we suggest ESAR or microprocessor-controlled foot and ankle components over solid ankle cushioned heel (SACH) feet to improve ambulation and patient satisfaction.” (p. 31) Supporting evidence: Evidence from 1 systematic review found benefits in gait symmetry when comparing energy storing and returning prosthetic feet and a microprocessor-controlled foot and ankle with powered push-off with SACH. A randomized controlled trial found that energy storing and returning prosthetic feet outperformed SACH feet on all biomechanical measures. Another randomized controlled trial found that a novel energy storing and returning prosthetic foot performed comparatively to other energy storing and returning prosthetic feet for walking performance. Finally, a randomized controlled trial found that there was higher quality of life outcomes for energy storing and returning feet with micro-processor-controlled foot and ankle components compared to solely energy storing and returning feet.	Quality of evidence: Very low certainty of evidence Strength of recommendation: Weak for
Department of Veterans Affairs and the Department of Defense (2022)⁶	
“For patients with major upper limb amputation (i.e., through or proximal to the wrist), we suggest use of a body-powered or externally-powered^a prosthesis to improve independence and reduce disability.” (p. 23). Supporting evidence: One cross-sectional study³³ found that the use of body-powered or externally-powered prostheses improves independence and reduces disability in patients with major unilateral upper limb amputation. The use of body-powered and externally-powered prostheses was associated with less difficulty performing activities, less disability, and higher physical function in most patients. There was no evidence to recommend 1 type of prosthetic over another.	Quality of evidence: Very low certainty of evidence Strength of recommendation: Weak for
Stevens and Wurdeman (2019)³⁶	
“Recommendation 2A: Microprocessor knee benefits: Compared with non-microprocessor knees: With respect to self-report indices and measures, microprocessor knees are indicated to reduce stumbles, falls, and associated frustrations as well as the cognitive	Quality of evidence: NR Strength of recommendation: NR

Recommendations and supporting evidence	Quality of evidence and strength of recommendations
demands of ambulation.” (p. 5) Supporting evidence: One trial found that transitioning from nonmicroprocessor knees to microprocessor knees resulted in a significant decrease in number of stumbles, semicontrolled falls, and uncontrolled falls. Another trial also found that microprocessor knee users experienced fewer stumbles and falls than those with a nonmicroprocessor knee. Frustration with falls was also reduced with the use of a microprocessor knee. A systematic review reporting evidence from 7 studies found that all studies supported the grade “B” recommendation that after moving from a nonmicroprocessor knee to a C-Leg, subjects will recall having reduced stumble and fall events. Another systematic review found that activities that require divided attention, like stair and hill descents, occur quicker with a microprocessor knee as compared to an nonmicroprocessor knee.	
“Recommendation 2B: Microprocessor knee benefits: Compared with non-microprocessor knees: With respect to self-report indices and measures, microprocessor knees are indicated to increase confidence while walking, self-reported mobility, satisfaction, well-being, and quality of life.” (p. 5) Supporting evidence: A cohort study reported that confidence in their microprocessor knees was observed in those who had switched from a nonmicroprocessor knee to a microprocessor knee. Self-reported mobility has increased with the use of a microprocessor knee compared to a nonmicroprocessor knee. Another study found increased energy burned over the course of a day with the use of a microprocessor knee despite having a nonsignificant decrease in oxygen consumption during ambulation. Two clinical trials have addressed both satisfaction and preference where participants were able to choose from either a microprocessor knee or a nonmicroprocessor knee after completion of the study and more chose microprocessor knees. Also, significantly higher satisfaction scores were observed with the use of a microprocessor knee. Two studies found that well-being scores increased when switching from a nonmicroprocessor knee to a microprocessor knee. In addition, 2 studies have found an increase in QALY values associated with the use of microprocessor knees.	Quality of evidence: NR Strength of recommendation: NR
“Recommendation 2C: Microprocessor knee benefits: Compared with non-microprocessor knees: With respect to physical performance indices and measures, microprocessor knees are indicated to increase self-selected walking speed, walking speed on uneven terrain, and metabolic efficiency during gait.” (p. 6) Supporting evidence: Self-selected walking speed increases with the switch from nonmicroprocessor knees to microprocessor knees in 4 studies. Several trials found that walking speed increased with microprocessor knees when walking on uneven terrain. Increased walking speed downhill has also been found. There have been studies that found that microprocessor knees allowed for improved qualities of movement for stair descent and hill descent. Two studies found that there were no significant differences in oxygen cost when switching from nonmicroprocessor knees to microprocessor knees. Two other studies have found that there was a decreased oxygen cost with microprocessor knees. Oxygen rate generally decreases with the use of microprocessor knees and a single study reported reduced perceived exertion with microprocessor knees.	Quality of evidence: NR Strength of recommendation: NR
“Recommendation 3: Microprocessor knee equivalence: Given the comparable values observed with the use of microprocessor and non-microprocessor knees with regard to daily step counts, temporal and spatial gait symmetry, self-reported general health, and total costs of prosthetic rehabilitation, these parameters may not be primary indications in prosthetic knee joint selection.” (p. 6) Supporting evidence: Two studies reported on step count, and number of and duration of activity bouts with microprocessor knees and nonmicroprocessor knees and found	Quality of evidence: NR Strength of recommendation: NR

Recommendations and supporting evidence	Quality of evidence and strength of recommendations
no significant difference in step-related activity outcomes. Two studies also found that general health with the use of microprocessor knees and nonmicroprocessor knees had nonsignificant improvements. When considering overall costs to society, including prosthetic acquisition costs, inpatient and outpatient care, hospital expenses, housekeeping, transportation, adaptive technology, and lost productivity, there was no significant difference when comparing microprocessor knees to nonmicroprocessor knees.	
“Recommendation 4. Microprocessor knees for limited community ambulators: Among limited community ambulators, microprocessor knees are indicated to enable increases in level ground walking speed and walking speed on uneven terrain while substantially reducing uncontrolled falls and increasing both measured and perceived balance.” (p. 6) Supporting evidence: A review on the effects of microprocessor knees for limited community ambulators found that there was increased self-selected walking velocity, ambulation across uneven surfaces, and an increase in descending slopes and hills. There was also a reduction in falls, and a significant decrease in the frequency of stumbles, uncontrolled falls, and frustration with falls in a similar population. Microprocessor knees were found to potentially enable community ambulators to perform activities that are typically for unlimited community ambulators.	Quality of evidence: NR Strength of recommendation: NR

ESAR = energy storing and return; NR = not reported; QALY = quality-adjusted life-year.

Note: This table has not been copy-edited.

^aExternally-powered prostheses include myoelectric prostheses. In this guideline document, an externally-powered prosthetic is “one characterized by at least one motorized joint, powered through a battery, and actuated by the user through one or more control inputs. The most common control inputs for externally-powered prostheses are electromyography (EMG) surface electrodes embedded into the socket. Externally-powered prostheses that utilize EMG electrodes are commonly referred to as ‘myoelectric’ prostheses.” (p. 81)⁶

Appendix 6: Overlap Between Included Systematic Reviews

Please note that this appendix has not been copy-edited.

Table 14: Overlap in Relevant Primary Studies Between Included Systematic Reviews

Primary study citation	Hahn et al. (2022) ²⁹	Thibaut et al. (2022) ³⁰
Burçak B, et al. <i>Ann Phys Rehabil Med</i> . 2021;64(1):101405.	—	Yes
Burnfield JM, et al. <i>Prosthet Orthot Int</i> . 2012;36(1):95 to 104.	Yes	—
Campbell et al. <i>J Rehabil Assist Technol Eng</i> . 2020;7:2055668320968476.	—	Yes
Davie-Smith F and Carse B. <i>Prosthet Orthot Int</i> . 2021;45(3):198 to 204.	Yes	—
Eberly VJ, et al. <i>Prosthet Orthot Int</i> . 2014;38(6):447 to 455.	Yes	—
Gerzeli S, et al. <i>Eur J Health Econ</i> . 2009;10(1):47 to 55	—	Yes
Hafner BJ and Smith DG. <i>J Rehabil Res Dev</i> . 2009;46(3):417 to 434.	Yes	—
Hahn A and Lang M. <i>J Prosthet Orthot</i> . 2015;27(3):86 to 95.	Yes	—
Hahn A, et al. <i>Medicine</i> . 2016;95(45):e5386.	Yes	—
Hasenoehrl T, et al. <i>Disabil Rehabil Assist Technol</i> . 2017;95:1 to 9.	Yes	—
Highsmith MJ, et al. <i>J Rehabil Res Dev</i> . 2016;53(6):753 to 66.	—	Yes
Highsmith MJ, et al. <i>Technol Innov</i> . 2016;18(2 to 3):139 to 50.	—	Yes
Highsmith MJ, et al. <i>Technol Innov</i> . 2016;18(2 to 3):151 to 7.	—	Yes
Highsmith MJ, et al. <i>Prosthet Orthot Int</i> . 2013;37(5):362 to 8.	—	Yes
Jayaraman C, et al. <i>J Neuroeng Rehabil</i> . 2021;18(1):88.	Yes	—
Kahle JT, et al. <i>J Rehabil Res Dev</i> . 2008;45(1):1 to 14.	Yes	—
Kaufman KR, et al. <i>Clin Biomech</i> . 2018;58:116 to 122.	Yes	Yes
Lansade C, et al. <i>Ann Phys Rehabil Med</i> . 2021;64(1):101386.	—	Yes
Lansade C, et al. <i>Ann Phys Rehabil Med</i> . 2018;61(5):278 to 85.	Yes	Yes
Lura DJ, et al. <i>Gait Posture</i> . 2017;58:103 to 7.	—	Yes
Lura DJ, et al. <i>Clin Biomech</i> . 2015;30:175 to 81.	—	Yes
Maaref K, et al. <i>Arch Phys Med Rehabil</i> . 2010;91(6):919 to 25.	—	Yes
Mileusnic MP, et al. <i>J Prosthet Orthot</i> . 2017;29(4):198 to 205.	Yes	—
Moller S, et al. <i>Prosthet Orthot Int</i> . 2019;43(3):257 to 65.	—	Yes
Moller S, et al. <i>Disabil Rehabil Assist Technol</i> . 2018;13(3):220 to 5.	—	Yes
Sen M, et al. <i>Acta Orthop Traumatol Turc</i> . 2020;54(5):502 to 6.	—	Yes
Theeven PJ, et al. <i>J Rehabil Med</i> . 2012;44(5):454 to 461.	Yes	—
Theeven PJ, et al. <i>J Rehabil Med</i> . 2011;43(10):906 to 915.	Yes	Yes
Wong K, et al. <i>Arch Phys Med Rehabil</i> . 2015;94(10): 804 to 810.	Yes	—
Wurdeman SR, et al. <i>Assist Technol</i> . 2020;32(5):236 to 42.	—	Yes



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