Opening the Black Box of Implementation: Developing the Creating Active Schools Logic Model

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ABSTRACT

Global guidance is driving systems thinking to the forefront of research, policy, and practice. To achieve this, we need to consider how things work to ensure successful implementation. The use of the implementation research logic model as a contemporary tool to aid the planning, reporting, synthesizing, executing, and evaluating of the novel Creating Active Schools (CAS) program is illustrated. A five-step iterative process, underpinned by the implementation research logic model, was undertaken to hypothesize and identify conceptual pathways between the CAS: 1) program determinants, 2) program components and actions, 3) implementation strategies, 4) mechanisms of action, and 5) outcomes. Throughout development, school-based and CAS stakeholders engaged in reviewing appropriate implementation theories, models and frameworks, terminology, and content. An in-depth CAS logic model was created to detail the CAS program and underpinning mechanisms. This article provides novel insights into how contemporary implementation tools can be applied and adapted to enhance the planning, reporting, synthesizing, executing, and evaluating of complex interventions and strategies. The CAS logic model provides a blueprint for future school-based interventions to develop evidence-based logic models and to increase the likelihood of acceptance, feasibility, and sustainability.

BACKGROUND

The World Health Organization recommends system-based approaches to increase physical activity levels (1). Yet, school-based efforts in the United Kingdom continue to focus on singular or multicomponent interventions because of the feasibility of implementing in a school context and challenges with complex evaluations (2,3). Such approaches increase pressure on schools, adding to overburdening and a fragmented circuit of activities (4). As a result, initiatives fail to embed in school culture leaving them vulnerable to failure (4). Unsurprisingly, recent reviews highlight current approaches as ineffective at preventing the decline in childhood physical activity (5–7). To address these issues, programs should embrace the complex adaptive needs of schools, evolve school cultures to support physical activity over time, ensure sustainable implementation, involve all stakeholders, and underpin initiatives with implementation and behavioral change theory (4,8,9). To support this new systems-based approach, a reprioritization of evaluations to understand "how it works" alongside "if it works" is essential (8).

To address these challenges, the Creating Active Schools (CAS) framework (Fig. 1) was codesigned with 50 stakeholders from research, policy, and practice (9). CAS presents the multiple components required to create whole-school cultural change for physical activity, summarized in four domains (policy, stakeholders, environments, and opportunities) (9). Unlike previous frameworks, CAS explicitly integrates the COM-B model of behavior change (which identifies three factors—capability, opportunity, and motivation—that must be present for behavior change to occur (10)), highlighting the importance of embedding behavior change into each component of a whole-school approach.

Although the use of behavior change theory is increasing in whole-school physical activity programs, few have been informed by implementation theories, models, and frameworks across all study phases: design, delivery, and evaluation (11). This may further explain the limited success of interventions delivered under real-world conditions or at scale, namely because there are

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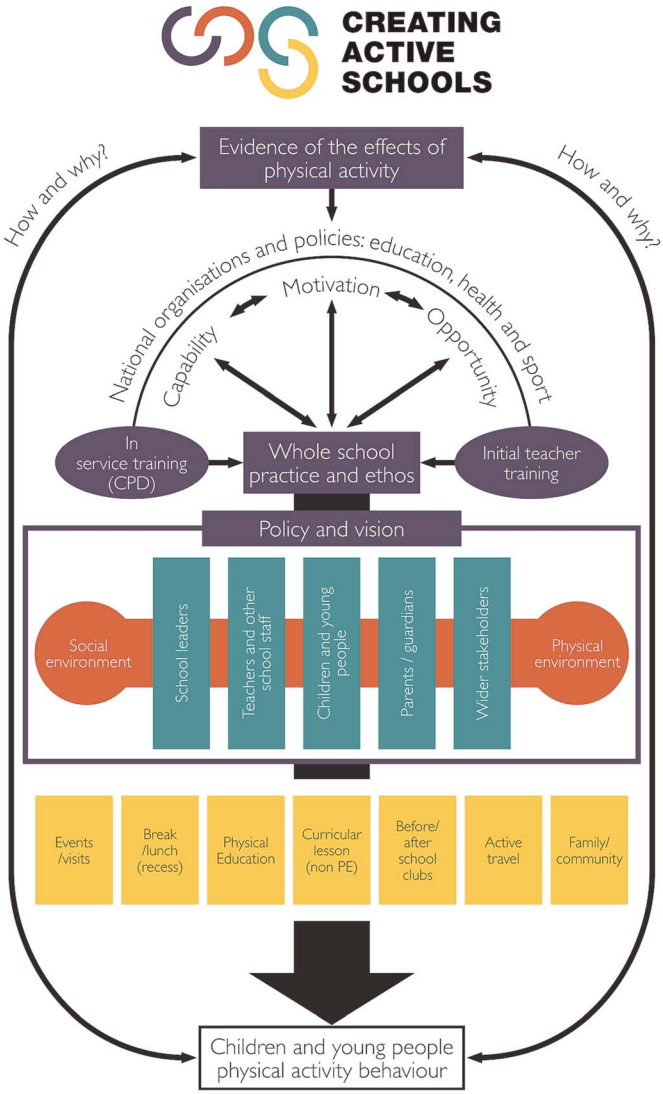

Figure 1: The CAS framework (reprinted from Daly-Smith et al. (9); CC BY 4.0). CPD, continuing professional development.

numerous barriers and facilitators to implementing a whole-school approach that are often not identified before (design), during (delivery), and after (evaluation) implementation (11,12). Hence, whole-school physical activity program implementation remains poorly understood. In the last 4 years, advances have been made to develop tools to support the planning, execution, and evaluation of school-based interventions (12–14). These tools have been successfully applied in multiple contexts, environments, and populations to identify the conceptual pathways and underlying mechanisms throughout an intervention's lifespan (14–16). Although previous whole-school physical activity logic models have been published (e.g., Action Schools BC! (17)), there are currently no examples making use of the recent advances.

In response, the CAS program—informed by the CAS framework (Fig. 1)—was developed to support schools to sustainably transform their whole-school physical activity culture (18). Embracing a systems-based approach, CAS recognizes the need to address the interactions between a program and the schools as multiple complex microsystems. To achieve this, CAS features flexible components that adapt depending on individual school context and stakeholders' perspectives, relationships, and local knowledge. The approach has been synthesized and reported in an implementation research logic model (IRLM), underpinned by multiple theories, models, and frameworks (14).

Logic models provide a graphic depiction of shared relationships among elements of a program/study (14). The IRLM builds on traditional logic models, improving the specification, rigor, reproducibility, and testable causal pathways involved in implementation research projects (14). As a result, the IRLM recognizes that iterative or retrospective application can enhance agreement between stakeholders regarding the foundations of a program, underpinning processes, and highlight theoretical and practical gaps in implementation (14). This iterative process aligns with the development of CAS as a complex, multilevel intervention that has emerged from 2 years of foundational work (19). Although the IRLM tool exists, to the authors' knowledge, there are no practical examples of how to apply and adapt this tool for whole-school approaches.

This article focuses on the development of an IRLM using the CAS program as a context and aims 1) to demonstrate how the IRLM can be used to guide the planning, reporting, executing, synthesizing, and evaluating of a whole-school approach; 2) to explain how the IRLM enhances understanding of the implementation of CAS; and 3) to prove the lessons learned throughout the process.

PROGRAM DESCRIPTION

The CAS program is a UK-based whole-school physical activity program integrating behavior change theory (e.g., COM-B model (10)) and implementation theories, models, and frameworks (e.g., Consolidated Framework for Implementation Research (CFIR)—designed to enable the identification of determinants across multiple levels of an organization (20)) (21). After development and pilot implementation in Bradford, UK, the program has been scaled up across England (~18 locality-based partnerships, ~200 schools). The CAS national team—consisting of researchers and practitioners from the University of Bradford, Yorkshire Sport Foundation, and Bradford Teaching Hospitals Foundation Trust—oversees the design, delivery, and evaluation of the program via partnerships operating at a local level (a conglomerate of one or more of the following entities: multiacademy trusts, active partnerships, local authorities, integrated care services, and school sport partnerships). Within the locality-based partnerships, CAS Champions are recruited and trained to work directly with their local schools. Using a professional development approach, the CAS Champion meets with their allocated schools at key points throughout the year to facilitate adoption and implementation. Once onboarded, schools start the four-stage annual CAS cycle, which aligns with the school improvement process (see table, Supplemental Content 1, http://links.lww.com/TJACSM/A238, which presents a description of the CAS program using the template for intervention description and replication (TIDieR) checklist (22)):

- Stage 1 (May–July): The CAS Champion supports in-school CAS leads to complete an online profile assessment of whole-school physical activity provision based on the four CAS framework areas: policy (five domains), environments (five domains), stakeholders (five domains), and opportunities (seven domains). After completing the profile, schools receive an automated summary score and recommended priority actions based on areas for high impact.
- Stage 2 (June–September): Schools select up to three priority areas, which are integrated into the school development plan for the academic year. The in-school CAS lead completes a planning for change document using the acceptability, practicability, effectiveness, affordability, spillover effects, and equity quality assurance criteria to identify evidence-informed initiatives to address the priority areas. The CAS Champion also identifies opportunities for shared school initiatives, informed by the locality data in the online profile dashboard, and creates communities of practice to support their implementation. This involves tendering for external support and identifying pioneering schools to support others for specific agendas (e.g., physical education (PE) or outdoor learning).
- Stage 3 (September–May): The in-school CAS lead completes the online continuous professional development modules and accesses resources and support tools based on their identified priorities. The locality leadership organizes termly conferences/communities of practice (three times per year) to support schools.
- Stage 4 (continuous): Schools are encouraged to concurrently monitor the effect of their initiatives through completion of the Sport England Active Lives Survey (23) and/or in-school surveys/focus groups with staff and pupils. These data subsequently inform the next CAS profiling exercise, starting the annual cycle for the successive academic year.

Unlike other whole-school physical activity approaches, CAS promotes data-driven decision-making at all levels of the system (individual schools, partnerships, and nationally). This is only possible because of codevelopment between researchers, practitioners, and policymakers at every stage of the CAS design, development, and evaluation process. It also reflects the integration and reciprocity of practice-led research and research-led practice to facilitate organizational and cultural change.

METHOD OF DEVELOPMENT

Ethical approval was granted by the Chair of Humanities, Social, and Health Sciences Research Ethics Panel at the University of Bradford (protocol code E926, date of approval: November 1, 2021). Where formal contributions were made to the content of the logic model, participants provided formal consent in alignment with the ethical approval. To develop the CAS logic model, the CAS research team—UK-based researchers (A.D.-S., A.C., Z.E.H., and J.L.M.) with expertise in school-based physical activity embedded within the CAS national team—led a five-step iterative design process across 12 months (Fig. 2). The CAS program is a multilevel intervention because its goal is to increase childhood physical activity by helping schools adopt a whole-school approach. To achieve this, CAS intervenes with school stakeholders across multiple levels of the school system to enhance physical activity provisions for students. However, because school stakeholders have to select which elements of the CAS program to use and implement, we used an approach informed by implementation science and guided by the IRLM to develop a logic model for CAS (14). The CAS logic model development process is detailed below.

CAS Logic Model Structure

The CAS logic model comprises five columns showing the program theory of change (Fig. 3). The model is deliberately presented in a different order than the process of development to enhance readability and evidence strings of logic. The columns include the following (Fig. 3):

1. Determinants of implementing physical activity at school and partnership levels aligned to the CFIR framework (20).

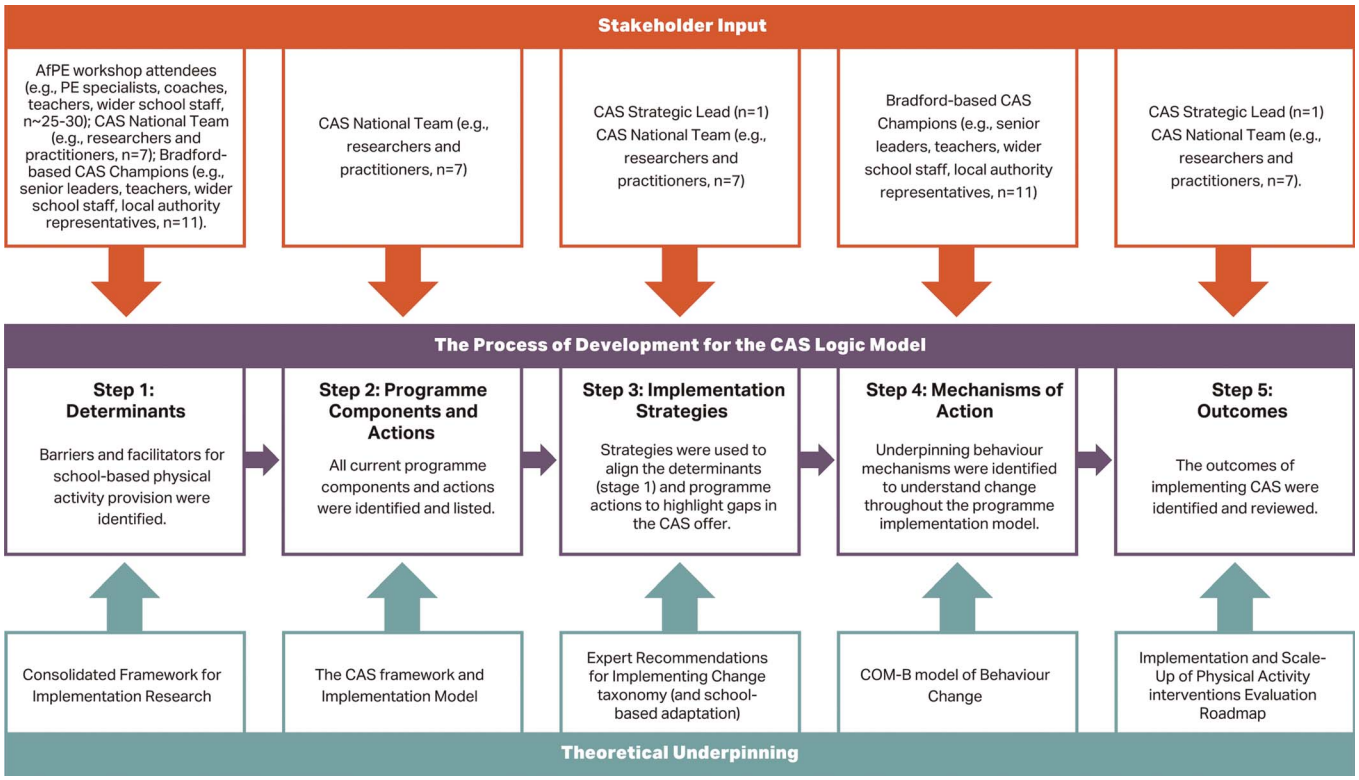

Figure 2: Process of developing the CAS logic model.

2. Nine implementation strategy domains of the Expert Recommendations for Implementing Change (ERIC) taxonomy and the school-based adaptation (see table, Supplemental Content 2, http://links.lww.com/TJACSM/A239, which presents the individual implementation strategies from each taxonomy) (12,24).
3. Program components and actions listed within the different levels of the program (school/partnership/national). Specific implementation strategies are numbered alongside the individual actions.
4. Mechanisms of actions aligned to COM-B framework, reported at each program level (school/partnership/national) (10).
5. Hypothesized implementation outcomes aligned to the Implementation and Scale-up of Physical Activity and Behavioural Nutrition Interventions evaluation road map (13).

Process of Development

To demonstrate the five-step development process in the context of the CAS logic model, an individual string of logic is detailed in Fig. 4.

Step 1: Determinants

The goal was to identify barriers and facilitators to whole-school physical activity provisions using the CFIR framework. Determinants are factors that may hinder (barriers) or enable (facilitators) implementation (14). CFIR is a common framework used to identify determinants across multiple levels of complex interventions and has previously been applied to whole-school physical activity programs (20,25). The CAS research lead consulted with attendees at a whole-school physical activity workshop at the 2021 Association for Physical Education conference (an annual conference for school stakeholders with a particular focus on PE (e.g., PE specialists, coaches, teachers, and school staff) to deliver professional learning and facilitate networking). After the workshop, the research team reviewed each determinant, refining as needed (e.g., amending terminology; discarding, combining, or adding determinants). Determinants were then aligned to the CFIR domains and subdomains before being reviewed by the CAS national team. To reduce bias and gain a holistic view of school-based stakeholders' perceptions, the Bradford CAS Champions (senior leaders, teachers and school staff, and local authority representatives) reviewed the determinants and their alignment to CFIR. Determinants were included in multiple subdomains of CFIR and across school, partnership, and national levels where appropriate (e.g., a key identified determinant was staff capability to deliver the program, which is in the characteristics of individuals domain of CFIR).

Step 2: Program components and actions

The goal was to identify CAS program components and actions (four-stage annual cycle) at the school, partnership, and national levels. In addition to the original IRLM process (14), the research team listed the components (e.g., onboarding schools and stakeholders) and underlying actions (e.g., contact

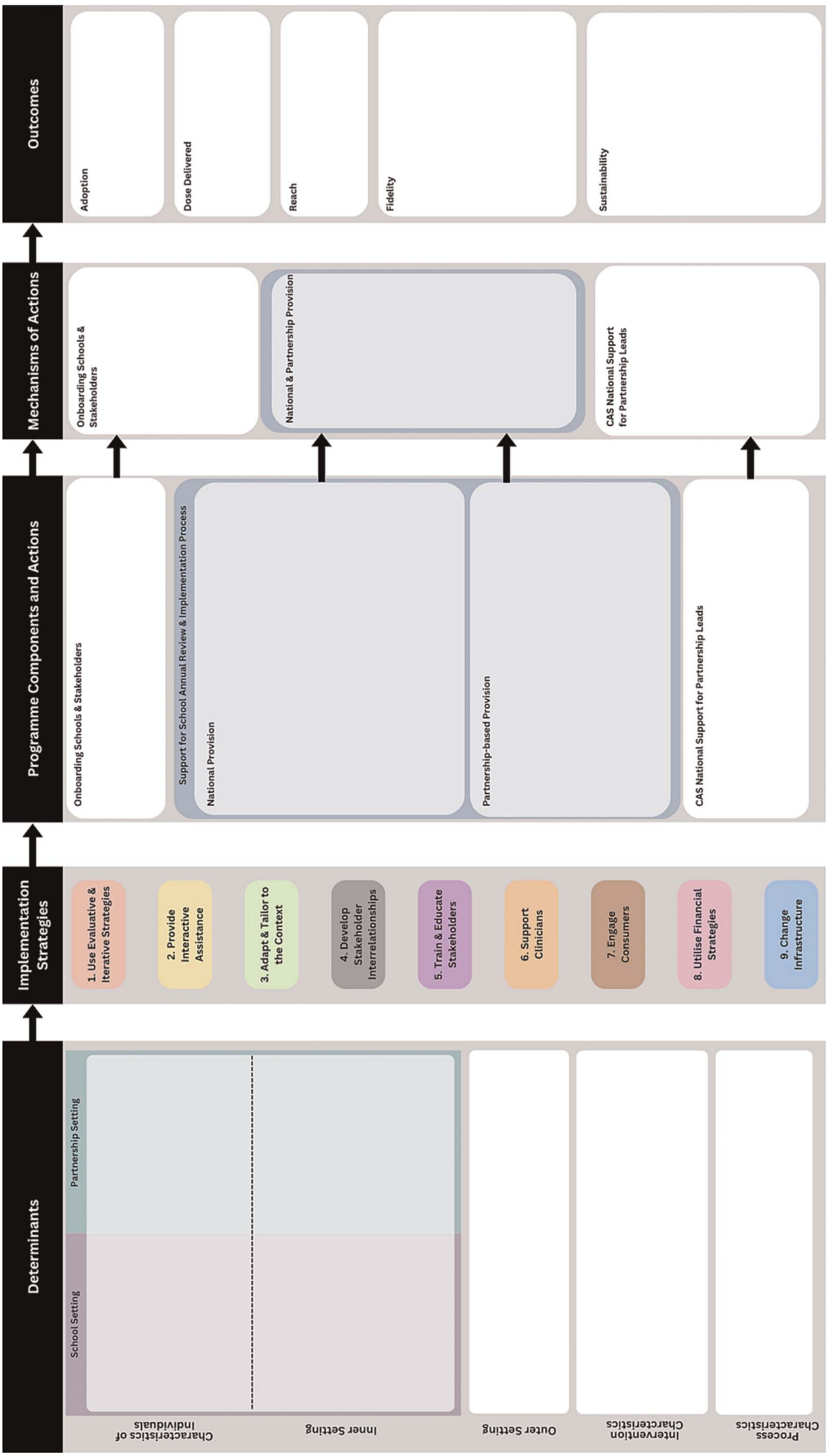

Figure 3: Structure of the CAS logic model.

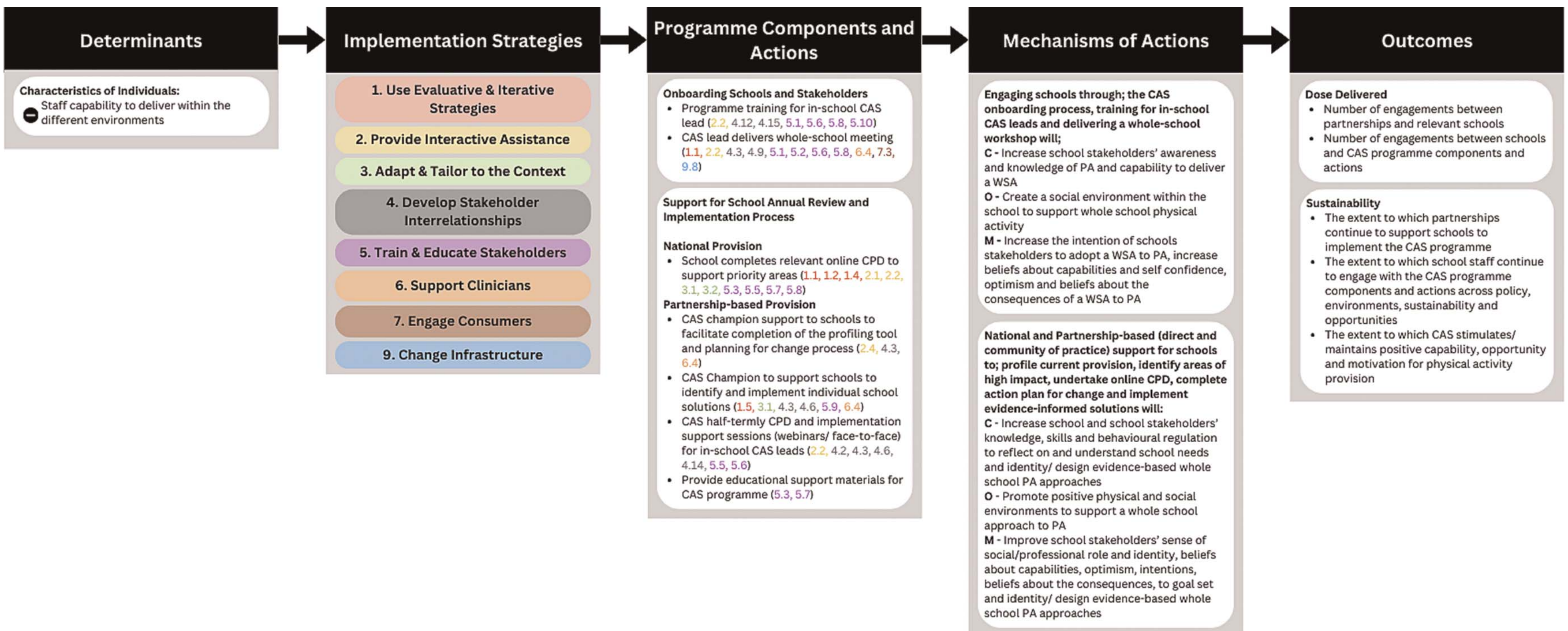

Figure 4: A single string of logic from the CAS logic model. CPD, continuing professional development; PA, physical activity; WSA, whole-school approach.

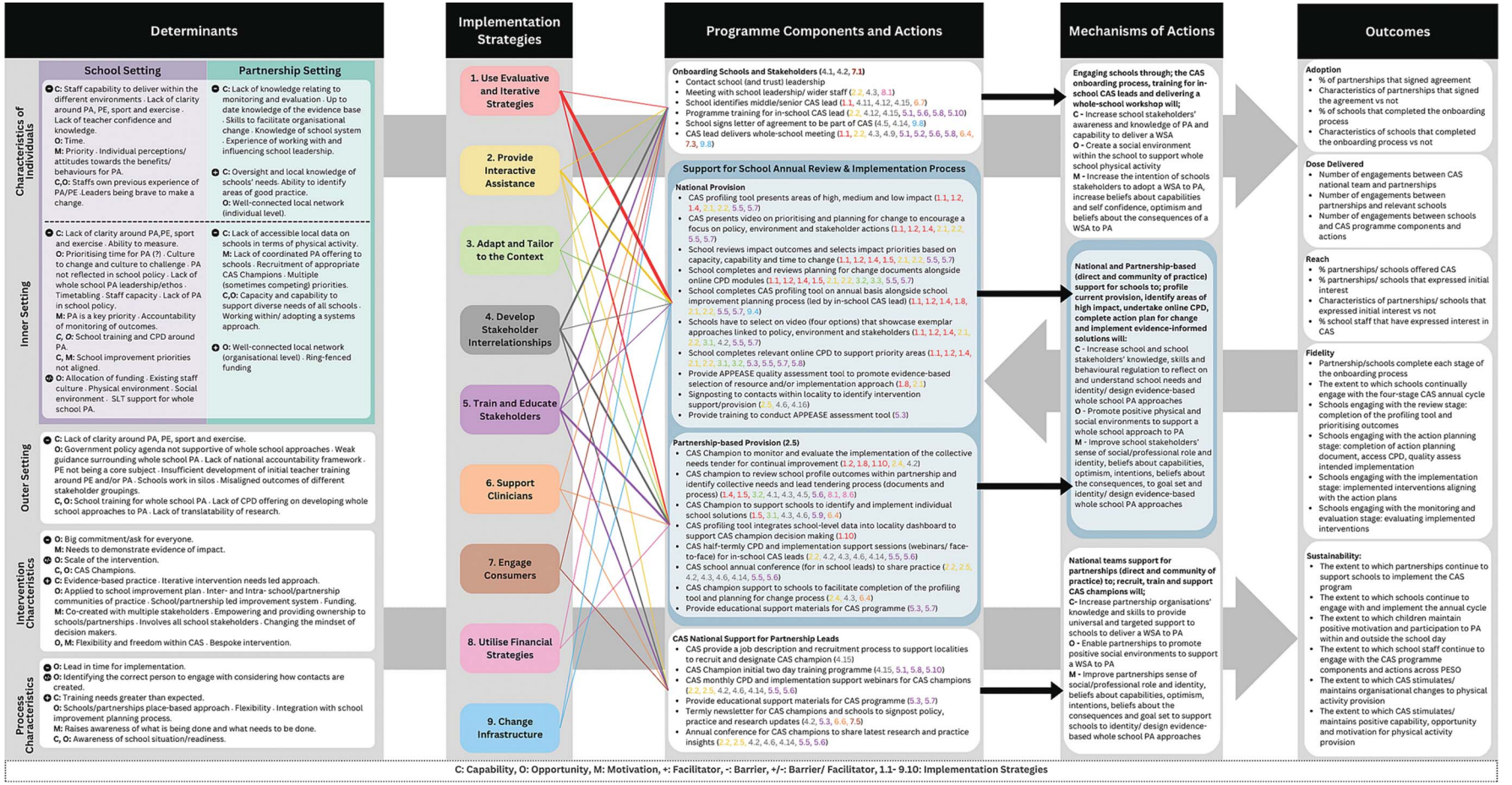

Figure 5: The CAS logic model. CPD, continuing professional development; PA, physical activity; PESO, policy, environment, stakeholder, and opportunity (CAS domains); SLT, senior leadership team; WSA, whole-school approach.

school and trust leadership; column 3, Figs. 3 and 5) of the CAS program to establish implementation strategies and highlight any gaps. The CAS national team reviewed the actions, aligning them with the appropriate operational level: school, partnership, or national. Lastly, the CAS research team aligned the actions to the determinants (column 1, Figs. 3 and 5). For instance, a key action identified was meeting with school leadership/wider school staff, which is in the onboarding phase of CAS and aligned with determinants such as physical activity being a priority and leaders being brave to make a change (further detail of this can be found in table, Supplemental Content 3, http://links.lww.com/TJACSM/A240, conceptual pathways between the program components and the actions, implementation strategies, and determinants).

Step 3: Implementation strategies

The goal was to link program components and actions to determinants through purposeful implementation strategies. Implementation strategies are methods or techniques used to enhance the adoption, implementation, and sustainment of an innovation (14). The ERIC taxonomy and school-based adaptation are comprehensive lists of implementation strategies that can be used to aid program implementation (12,24). Both taxonomies were reviewed by the research team, who aligned each program action to the appropriate taxonomy domain(s) (column 2, Figs. 3 and 5) and individual strategies (column 3, Figs. 3 and 5). Uncertainties and disagreements were noted, reviewed, and resolved by the CAS strategic lead. For example, the action of meeting with school leadership/wider school staff was aligned to the individual strategies to provide interactive assistance (facilitation, develop stakeholder relationships), to conduct local consensus discussions, and to use financial strategies (access new funding).

Step 4: Mechanisms of actions

The goal was to identify behavioral mechanisms that operate at each level of the CAS program. Mechanisms of action are the processes through which an implementation strategy works to achieve implementation outcomes (14). The CAS research team identified behavioral mechanisms using the COM-B framework because it is embedded within the original CAS framework (10,14,21). The COM-B framework proposes three behavioral concepts (capability, opportunity, and motivation) that must be present for an individual to engage in a behavior (10). All program components and actions (column 3, Figs. 3 and 5) were assessed against the COM-B framework to hypothesize underlying mechanisms related to organizational and stakeholder behavior for physical activity provision. This ensured a comprehensive view of the causal processes and proximal outcomes across the multiple program levels (10). Each determinant (column 1, Figs. 3 and 5) was reviewed by the research team and aligned with COM-B to increase comprehensiveness and to strengthen the rigor of conceptual pathways (column 4, Figs. 3 and 5) (14). Feedback was sought from the Bradford-based CAS Champions to confirm alignment and terminology. For example, a key mechanism of action was to increase school stakeholders' awareness and knowledge of physical activity and their capability to deliver a whole-school approach through the CAS onboarding process, which was identified as a capability mechanism.

Step 5: Outcomes

The goal was to identify CAS program implementation outcomes at the school, partnership, and national levels. Implementation outcomes are often referred to as the effects of deliberate and purposive implementation of treatments, services, and/or practices (14). The implementation outcomes identified on the Implementation and Scale-Up of Physical Activity and Behavioural Nutrition Interventions evaluation road map were reviewed by the research team to elicit system-level outcomes of the CAS program (column 5, Figs. 3 and 5) (13). To reduce redundancy, only the implementation outcomes were incorporated because the determinants are also grounded in CFIR (13,20). For example, the outcome, the number of engagements between schools and CAS program components, and the actions are in the dose delivered domain of the road map.

THE CAS LOGIC MODEL

The full CAS logic model is presented Fig. 5 (see table, Supplemental Content 3, http://links.lww.com/TJACSM/A240, for more granular detail of the alignment of each determinant to program components, actions, and mechanisms of action). We appreciate that the logic model is presented in a linear way; however, we recognize the need for continuous feedback loops. This enables the adaptive nature of place-based approaches and systems thinking. As a result, feedback has been built into CAS through specific actions (e.g., annual completion of the CAS profiling tool to highlight areas of impact and identify new goals after progress or regression) and mixed-method evaluations of the intended and unintended effects/outcomes.

DISCUSSION

The current article provides a blueprint for the application of the IRLM process to develop a scalable whole-school physical activity program. We lean into the adaptable nature of the IRLM to showcase how it can be applied to future complex interventions. Specifically, identifying program components and actions (column 3, Figs. 3 and 5) improves the practical application of the IRLM and demonstrates its ability to adapt to the needs of complex multilayered interventions. As a result, this detailed logic model provides a transparent overview of the entire program, not often seen in academic studies of whole-school approaches. The codesign process and resultant model revealed the inherent complexity and time required to address true whole-school approaches delivered at scale. Undertaking the IRLM process strengthened the design, delivery, and evaluation of the CAS program by synthesizing current provisions and identifying gaps that required additional program actions. As a result, we were able to open the "black box" of program implementation by identifying granular details and underlying mechanisms in a national whole-school physical activity program.

One of the common challenges with interventions and implementation strategies is many of the mechanisms of action are not reported or made explicit (14). Rather, they are retained within the black box and not fully described. Even contemporary physical activity interventions and implementation strategies struggle to evidence their mechanisms of action despite using logic modeling approaches (17). By contrast, the CAS logic model showcases a complex systems-based approach to tackle whole-school physical activity, enabling us to synthesize and report the implementation of CAS in its entirety. Using the

IRLM process, we were able to reveal the complexity of the CAS program and report the multiple layers and underpinning mechanisms required for whole-school approaches and operations at scale (14). By describing these processes and providing a level of specificity not reported before, this article provides a blueprint for opening the black box of implementation and turning it into a "glass box." This takes time; in Bradford, a 2-year iterative development process was essential to design, test, and refine the CAS program components and actions (21). Such investment was key to informing the development of the CAS logic model. It is recommended that future programs ensure sufficient lead-in time as part of their development process to ensure practice fit and the comprehensiveness of their approach (26).

Global policymakers advocate whole-school approaches for an array of health behaviors (1,27). We have demonstrated the practical application of the IRLM process to a whole-school approach for physical activity. By showcasing how the process can adapt to the needs of the CAS program context and stakeholders, this article can inform the development of other complex and systems-based approaches beyond physical activity (14). To ensure acceptability, future interventions should embrace the opinions of key stakeholder groups (e.g., senior leaders, teachers, and school staff) into their development processes (8). This article showcases how input from stakeholders like researchers, government organizations, national educational partners (e.g., charities), and school staff can enhance the value of the IRLM process and secure future buy-in (28). Engaging school-based stakeholders (e.g., senior leaders, teachers and wider school staff, PE specialists, and coaches) in this way provided a holistic view of the program and highlighted gaps within the current provisions (e.g., where new actions were needed to address identified determinants).

As an extension of the original IRLM, we identified program components and actions (column 3, Figs. 3 and 5). This additional step was necessary to synthesize the current program provisions. By doing so, we represented both what was actually happening (program components and actions) and what was theorized to happen (mechanisms of actions). Recent attention has focused on the need to understand how strategies operate in practice (29,30); by including this step of development, we have strengthened the alignment of implementation strategies with determinants and mechanisms of actions to enhance testability (14,30). On reflection, this was a key feature of the logic model development and facilitated an iterative cyclical process of program review and refinement. This will be important as CAS is adopted more widely and in different contexts. Hence, this article rationalizes the iterative application of the IRLM and the synthesis of program components and actions to enhance implementation and evaluation.

One challenge in implementation science is the reproducibility of complex interventions (14). The CAS logic model helps to enhance the transparency of how the program operates. As a result of applying the IRLM, we were able 1) to synthesize the CAS program provisions, 2) to plan additional actions to fill identified gaps, 3) to represent the CAS program using a compact visual depiction, 4) to execute the national program with standardized components, and 5) to develop a holistic evaluation plan (14). We found the IRLM process exposed and magnified every aspect of the CAS program to a degree not previously anticipated. Although daunting, this highlighted areas in which we made assumptions and needed to develop additional components, actions, and/or strategies to achieve the desired outcomes. An added benefit of undertaking this approach has been that the logic model has a high degree of practical application and can be used by the program delivery team. Hence, complex interventions should strive to use similar methods to aid the rigor and transparency of their approach to overcome a common lack of reproducibility (14).

To support systems-based approaches, it is essential for program evaluations to understand "how it works" in addition to "if it works" (8). The identification of implementation outcomes (i.e., reach, adoption, dose, fidelity, and sustainability) across multiple levels (school, partnership, and national) emphasizes the need to diverge from the traditional research pipeline and embrace hybrid evaluations that equally value implementation and effectiveness (13,14). Evaluation methods used in isolation are likely insufficient to gain a comprehensive understanding of a complex program. Such methods often overlook unintended effects that have the potential to act as catalysts or inhibitors of further processes (31). Instead, contemporary frameworks can guide the integration of novel mixed-method research designs to understand current school-based physical activity due to the complex contextual, environmental, and population factors that influence program implementation and effectiveness (28). The outcomes within the logic model were not designed to suggest a direction of change, but a need to understand changes within that component of implementation; therefore, there is room for the identification of unintended outcomes. Further, the research methodologies used to evaluate CAS (e.g., ripple effects mapping (32)) promote insights into intended and unintended outcomes. By triangulating mixed methods, we can begin to progress our understanding of what works, for whom, in what context, and why (25). This kind of approach is imperative within place-based research to enhance understanding of the implementation (adoption, fidelity, dose) and longitudinal effect (reach, sustainability) (13,32). Thus, future evaluations should consider mixed methods to gain increased understanding of program implementation and effectiveness.

Future Directions

Future whole-school approaches and complex interventions are encouraged to follow the CAS logic model development process as a blueprint to enhance their transparency and reproducibility. In addition, the process benefits from engaging with key stakeholder groups (e.g., senior leaders, teachers and school staff, and wider stakeholders) to ensure acceptability and feasibility. In combination, these recommendations are likely to enhance the effectiveness of the design, implementation, and sustainability of interventions. Furthermore, as our understanding of implementation develops, future research should seek to reflect current practices. For example, understanding the newly proposed CFIR 2.0 and what modifications are necessary could benefit the CAS IRLM.

Strengths and Limitations

This is the first attempt at developing an iterative IRLM for a whole-school physical activity program. Consequently, the article advances the implementation and school-based physical activity research fields by providing novel insights into the application of the IRLM to plan, synthesize, execute, report, and evaluate a whole-school approach for physical activity. There

are several strengths of our approach. Involving a variety of stakeholders (CAS and school based) at each level of the program provided consistency and clarity and reduced bias, particularly in relation to the terminology used within the logic model (14). Additionally, we drew on multiple theories, models, and frameworks when designing the logic model to detail different concepts relevant to CAS that could be operationalized and measured (33). Such an approach has been suggested as beneficial when conducting public health intervention research (34). This can be used to inform future evaluations of CAS and help to advance the evidence base for implementing whole-school approaches to physical activity more broadly.

The comprehensive approach adopted to develop the logic model allowed the complexity that underlies CAS to be acknowledged. Engaging multiple stakeholders in this process was key, and although time consuming, it provided a holistic understanding of the program that would not have been possible without taking such iterative steps. Furthermore, this process contributed to the robustness of the model and facilitated the development of a blueprint for others to follow for enhancing the design, delivery, and evaluation of future whole-system, place-based approaches.

CONCLUSION

This article provides novel insights into the first UK-based whole-school physical activity approach reported using an IRLM. Showcasing the CAS logic model development process and presenting the granular program detail will help advance the future of planning, synthesizing, executing, reporting, and evaluating complex interventions. By opening the "black box," we have identified the multiple implementation strategies leveraged by CAS that operate across multiple levels in a systems-based approach. Therefore, this article provides a blueprint for future whole-school approaches and broader complex interventions to develop IRLMs and to increase the likelihood of adoption, acceptance, and sustainability.

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