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Canine-Assisted Interventions and the Relevance of Welfare Assessments for Human Health, and Transmission of Zoonosis: A Literature Review

Lieve Lucia Meers[1], Laura Contalbrigo[2], William Ellery Samuels[3], Carolina Duarte-Gan[4], Daniel Berckmans[5], Stephan Jens Laufer[1], Vicky Antoinette Stevens[1], Elizabeth Ann Walsh[6] and Simona Normando[7]*

[1] BIAAT Foundation, Genk, Belgium, [2] National Reference Centre for Animal Assisted Interventions, Instituto Zooprofilattico, Legnaro, Italy, [3] Hunter College, School of Nursing, The City University of New York, New York, NY, United States, [4] Department of Psychology, Faculty of Humanities and Educational Sciences, University of Jaén, Jaén, Spain, [5] Department of Biosystems, Katholieke Universiteit Leuven, Dier en Mens, Leuven, Belgium, [6] Cork Pet Behaviour Centre, Cork, Ireland, [7] Department of Comparative Biomedicine and Food Science, University of Padua, Padua, Italy

CAIs (canine-assisted interventions) include "canine-assisted therapy" in which a therapist sets client-oriented goals, 'canine-assisted activities' with recreational goals for clients, and 'canine-assisted education/learning' in which teachers or coaches create learning goals for students or clients. CAIs vary in nearly every way; their only common trait is the involvement of dogs to respond to human need. However, the benefits of involving dogs are highly dependent on the animal's health and behavior. A dog exhibiting negative behavior or an unwell dog might pose a risk, especially for CAI target groups, specifically individuals with immunosuppression, chronic illness, children, elderly, etc. Therefore, positive animal welfare as preventative medicine to avoid incidents or transmission of zoonosis is an attractive hypothesis, with implications for human and animal, health and well-being. This review aims to summarize the current published knowledge regarding different aspects of welfare in CAIs and to discuss their relevance in the light of health and safety in CAI participants. As method for this study, a literature search was conducted (2001–2022) using the Prisma method, describing issues of dog welfare as defined in the Welfare Quality® approach. This welfare assessment tool includes 4 categories related to behavior, health, management, and environment; it was, therefore, applicable to CAIs. Results indicate that dogs working in CAIs are required to cope with diverse variables that can jeopardize their welfare. In conclusion, we propose regular welfare assessments for dogs in CAIs, which would also protect the quality of the CAI sessions and the clients' safety and well-being.

Keywords: canine-assisted interventions, welfare, zoonosis, preventative medicine, human animal interaction (HAI)

INTRODUCTION

An increasing number of papers suggest that canine-assisted interventions (CAI) may have physical and psychological benefits for numerous target groups of varying ages and diagnoses (1–5). Neutral or positive impacts of CAI sessions on dog welfare are documented, based on physiological parameters (e.g., oxytocin levels, a negative feedback regulator that culminates with a decrease in cortisol, heart rate or blood pressure (6–17) and behaviors such as playing, leaning toward, nudging, sniffing or licking the client (18–22). The dog's temperament and individuality is seldom investigated, although it is likely that this influences physiological and behavioral outcomes (23).

Several studies report that the benefits of CAIs are greater than the risks (24–28), nevertheless some find potential stress or welfare risks in dogs a valid reason not to use CAIs (24, 29–34). Contra-indications for CAIs, include fear/phobia of animals, cultural attitudes (29), unsafe animal behavior (30, 35), allergic reactions (36), workload (37, 38), funding (39), concerns regarding hygiene/sanitization (39), or zoonotic transmission of diseases (40, 41).

Legislative frameworks such as the National Guidelines for AAI (42) in Italy stipulate that before joining CAIs, dogs must pass a veterinary assessment of their physical health, behavior, and welfare (43). The Austrian Ministry of Labor, Social Affairs, and Consumer Protection Initiative legally regulates therapy dogs, stipulating regular health/temperament/behavior checkups to re-evaluate an animal's suitability (44). In Germany, the integration of animals in AAIs is legally regulated, and animal handlers must provide evidence of their species-specific knowledge (45). In the USA, a few states have enacted public access laws for handlers with therapy animals comparable to that granted to service animal handlers (46). In other countries, the national and/or municipal animal protection/welfare legislation applies. Currently, no universally agreed welfare protocol exists (47, 48). Organizations that deliver CAIs and those that evaluate and register CAI dogs often have their own procedures for screening and instructing dogs and their handlers (49), posing a challenge to safe CAI sessions (50, 51).

This review aims to provide information on those welfare issues in CAI dogs that might cause health problems in CAI participants.

METHODS

This review was conducted according to the protocol of the PRISMA group (52, 53). Only studies published between 2001–2022, a period during which CAIs increased prolifically, were selected to ensure a complete overview, while publications not written in English, case reports, (doctoral) theses, book chapters, conferences, commentaries, and notes were excluded. Publications reporting on welfare risks to dogs that might be related to physical problems in CAI participants were included; studies concerning assistance dogs were excluded. Three electronic scientific databases were searched: PubMed (54), Google Scholar (55), and Web of Science (56). The systematic search was performed in May 2022, by two of the authors

TABLE 1 | Search string used in Google Scholar, Web of Science, PubMed.

| |
|---|
| (1) "animal-assisted therapy" OR "therapy dog" AND welfare |
| (2) "animal-assisted therapy" OR "therapy dog" AND "raw meat" |
| (3) "animal-assisted therapy" OR "therapy dog" AND zoonosis |
| (4) "animal-assisted therapy" OR "therapy dog" AND "One Health" |
| (5) "animal-assisted therapy" OR "therapy dog" AND abuse OR "dog bite" |

(LM, CD-G) independently, using 5 strings (**Table 1**) in the Harzing's Publish or Perish software (57). The cut-off was set on 500/string (PubMed and Google Scholar) and 50/string (Web of Science). All terms were selected based on international reference guidelines for AAIs (58, 59) and the Welfare Quality model (60, 61). References from selected papers were revised and used as supplementary information sources. All data were entered into an Excel data set. We included data related to the welfare risks of dogs as described in the Welfare Quality model, possible physical consequences for CAI participants, and additional data to facilitate the identification of each study (e.g., authors, title, and year of publication). After excluding duplicates; titles and abstracts were evaluated (**Figure 1**). A total of 423 papers met the inclusion criteria and underwent full-text screening *via* Sci-Hub, OpenAccess, and DeepDyve. Finally, 118 articles were selected in consensus for relevance to the topic.

WELFARE QUALITY® CONCEPT

Management

Good management implies for example that dogs must have unlimited access to clean water, especially during CAI visits, as temperatures in nursing homes/clinics may be high (62). Also the appropriate quantity of food is important to avoid overfeeding, obesity and, if under-exercised, welfare issues such as congestive heart failure (63, 64). Obesity in CAI dogs is often related to food-rewarded activities/training.

Feeding a raw meat diet (RMD) is another contentious issue (50, 65, 66). RMD's include various dietary formats ranging from incomplete, unprocessed (i.e., unsterilized) foods to complete, balanced, sterilized diets (67). Proponents of RMD reference that these diets release maximum thermodynamic free energy (68) and increase the relative abundances of bacteria associated with protein and fat utilization, including members of the genera Fusobacterium and Clostridium. In humans, these genera are more commonly associated with disease (69). Some AAI institutional guidelines prohibit feeding RMDs, raw eggs, or raw treats such as dried pig ears to dogs participating in CAIs (49, 70) because these diets are linked to nutritional imbalance (70, 71), contagious viruses such as Pseudorabies (Aujeszky's disease) or (72), bacterial pathogens such as *Escherichia coli*, *Listeria* spp., *Clostridium*, *Salmonella* spp., *Campylobacter*, and parasitic pathogens such as *Cryptosporidium*, *Sarcocystis cruzi*, *Sarcocystis tenella*, *Toxoplasma gondii,* and *Neospora* (73–78). Additionally, a study by Finley et al. (79) showed that 7 out of 16 dogs fed RMDs contaminated with *Salmonella*, shed *Salmonella* serovars in their stools for up to seven days after consumption, even though the dogs did not subsequently exhibit clinical signs of disease. Recent

FIGURE 1 | Flow diagram of the steps followed in the search strategy (53).
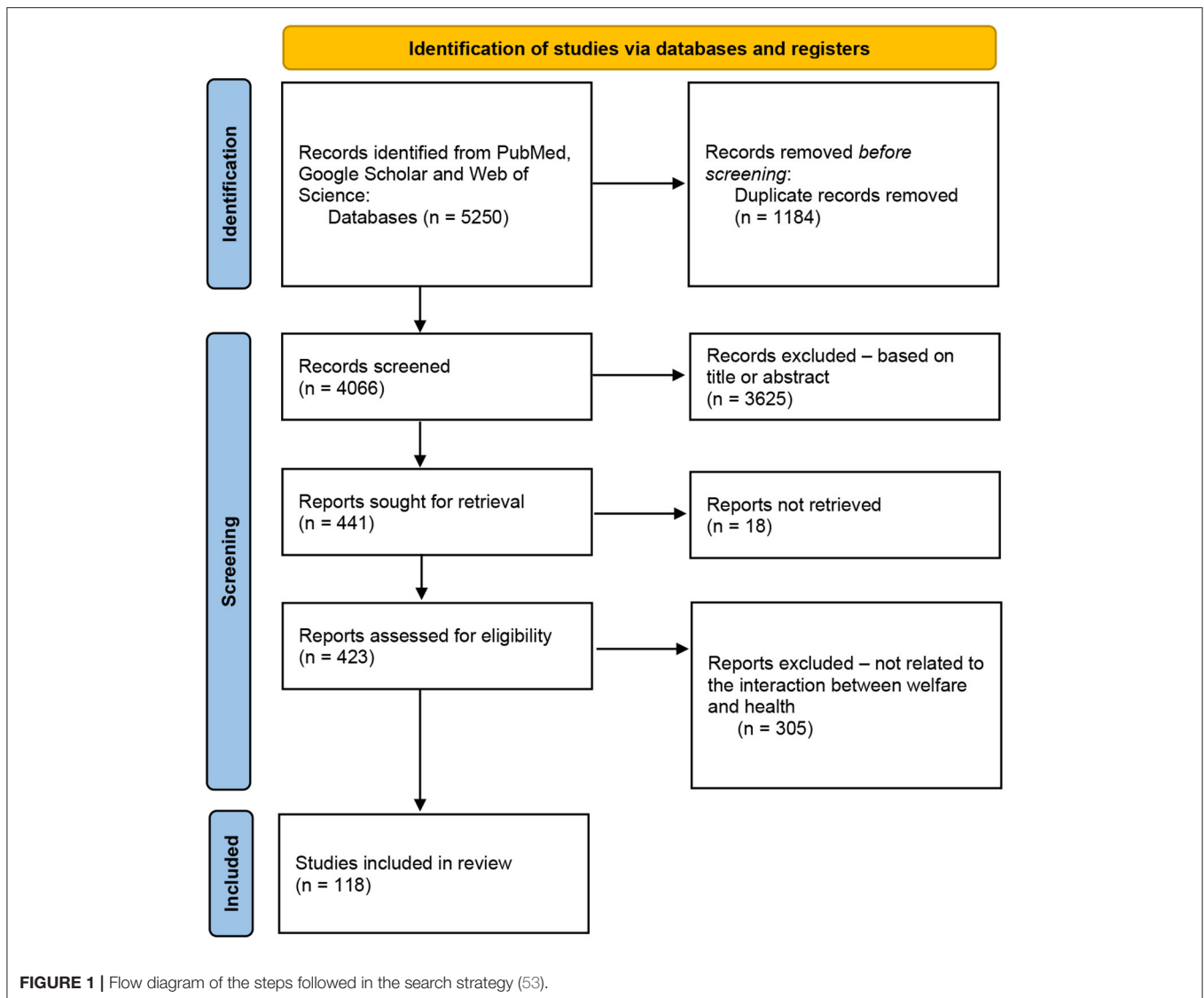
reports linked RMDs to *Mycobacterium* (*M.*) *bovis*, which is one of the member species of the Mycobacterium tuberculosis complex (MTBC). It is not proven that dogs having had contact with mycobacterium *via* RMDs may transmit this zoonosis to humans, however, *M. bovis* is capable of causing tuberculosis across a broad taxonomy of species, including humans (80, 81).

Another welfare parameter that may be relevant is the food and drink that clients share with dogs during CAI activities. Clients may bring left-overs from their own meals to reward the dogs. However, some human foods contain components that are unhealthy or even toxic to dogs such as grapes, chocolate, or nuts (50, 62, 82). Moreover, feeding dogs means direct contact with dog saliva, a possible source of contact with commensal zoonotic pathogens resident in the dogs' oral cavities (62, 83). Such pathogenic species include *Pasteurella* spp. and *C. canimorsus,* which can cause infections, pneumonia, meningitis, or ulcerations in humans if licked in the ears, mouth, or in surgical wounds (84). Some institutions may therefore request

that treats are deposited in a bowl to avoid direct contact between the client's hand and the dog's mouth (82). Regular disinfection of food and water bowls between CAI settings may be in place to reduce the risk of exchange of pathogens and to improve dog welfare during CAI sessions (82).

Environment

CAIs are conducted in indoor facilities such as clinics, healthcare facilities, community centers, prisons, libraries, schools, retirement communities, homes, and outdoors in fields and forest (85). Welfare factors are influenced by the novelty of the environment, appropriate arrangements for canine specific morphology (47), access to a private/rest space, possibility to retreat out of view of clients, the frequency and duration of time spent in contact with clients (31).

As each environment has its own benefits and challenges, safety guidelines are seldom agreed upon. For example, in hospitals, wheelchairs and orthopedic equipment can pose a

danger to animals (35); dogs might become entangled in IV bags and lines, (50) or accidently swallow medication (86). In outdoor settings, due to climate change, it may be important to note that ticks, are questing around in fields at air and soil temperatures as low as 2.5°C (87, 88). Tick bites are associated with the risk of catching Lyme disease sometimes with opportunistic co-infections such as chlamydia pneumonia, or mycoplasma transmissions (89). In recent years, there has been an increase in the number of case reports describing clinical tick-born encephalitis (TBE), a tick-borne viral disease, in dogs, with some coming from previously non-endemic areas, raising concerns. Currently, TBE vaccination is available for humans. First results indicate that human vaccines can be used in dogs but further studies are urgently needed (90).

Another challenge to meet for CAIs that are organized in woody areas is (in)direct contact (*via* dog saliva) with the hair of the oak and pine processionary caterpillar, a mechanic and toxic mechanism (lepidopterism) which can cause dermatitis, cutaneous reactions (weal and flare reaction), ocular lesions or upper respiratory tract reactions in humans. In dogs, this can cause labial angiooedema, ptyalism, sloughing, tongue swelling, stomatitis, conjunctivitis or respiratory distress (91–93).

Other ectoparasites such as mites and fleas (50) can cause health and welfare problems in dogs and humans if left untreated, and cause zoonosis such as *Bartonella* spp. (94) or flea allergy dermatitis in humans and dogs (95). Testing for endoparasites in dogs is also essential from a welfare perspective. Eggs, larvae, cysts, and oocysts excreted *via* the canine fecal route can survive and be infectious in the environment over a long period of time and under different conditions (96, 97). Dog feces deposited on soil in city parks/gardens are an inconvenience, and can pose a health threat such as the spread of Giardia or Toxocara eggs which can be transferred from animals to humans by fur contact (98–100). The effect of parasitic worms on clients can be complex, as they may have beneficial and/or adverse effects on clients' immune systems; an example being, definitive host helminth infections may confer protection from allergies however zoonotic helminths, such as *Toxocara* (spp.), may increase human allergy and asthma risks (101). *Toxocara* (spp.) can reproduce in dogs but not in humans; however, the larva can remain encapsulated in eggs for years in the human body. Yogi et al. (101) shows that young people who test positive for this parasite have a four times higher risk of developing asthma and allergies than others. Finally, some studies associate neurotropic parasitic diseases such as toxoplasmosis with mental disorders, and toxocariasis is associated with an increased risk of schizophrenia and/or bipolar disorders. People diagnosed with Chagas disease and/or neurocysticercosis have a higher risk of developing anxiety and depressive disorders (102). Therefore, CAI organizations ask that dogs involved in CAIs be tested annually by a veterinarian (negative stool and negative heartworm) and receive regular preventative treatment for parasites. Nevertheless, Gerardi et al. (103) showed a presence of four zoonotic parasites (nematodes and protozoa) in CAI dogs that were properly treated, demonstrating an urgent need for extra prevention measures.

Most protocols agree that dogs should be washed, and groomed within 24 h prior to contact with clients (49, 65, 66, 82). Washing a dog at least twice a week might be stressful for the animals (104), but it may help reduce Can f1 from dog hair and dander and lower the risk for allergic reaction (105). Allergies can cause skin irritations, allergic rhino-conjunctivitis, and allergic bronchial asthma. They are a contraindication for CAIs as they occur when in (in)direct contact with dogs (36).

Involving inappropriately termed hypoallergenic animals, such as labradoodles, does not provide an allergen-free environment (36). Moreover, Vredegoor et al. (106) found that Can f 1 in the hair and coat, a component that counts for at least half of the allergenic activity, was higher in these dogs than in control breeds such as Labrador retrievers. From a welfare aspect, the allergological risks of implementing CAIs in a hospital or outpatient setting should not be underestimated (36). Toshihiro et al. (107), shows that only the complete avoidance of animals was effective in patients with animal allergic asthma. Therefore, Schmidt et al. (36) states that emergency medication must be available to a trained person on site, to mitigate risk, in the event of an allergic response.

Good Health

Some studies reveal that staff members oppose CAIs because of their fear of zoonosis (108–110). Lefebvre et al. (111) shows that transmission of zoonotic bacteria, viruses, or fungi between dogs and humans *via* infected saliva, aerosols, contaminated urine or feces, and direct contact is possible during CAIs. Therefore, most protocols request that dogs not exhibit indicators of poor health (e.g., vomiting, diarrhea, lethargy, etc.), take immunosuppressive medications or antibiotics during CAIs (49). Prior to starting CAI's, dogs should be in a permanent home for 6 months and be a minimum of 1 year/old. Puppies <16 weeks may be more susceptible to becoming sick as their immune systems are less strong than adult dogs (49) and more often carry parasites (112). However, some CAIs do involve puppies as they elicit a strong nurturing response from clients, and the handling experience of the visit may enhance the puppies' maturation and socialization (62). Many protocols request up-to-date vaccinations (rabies, parvovirus, distemper/canine adenovirus, leptospirosis, Bordetella, and canine influenza), and a yearly medical checkup by a veterinarian (49).

However, some studies (25, 97, 111) show that dogs judged to be in good health can become asymptomatic carriers of infection (e.g., Clostridium difficile, MDR bacteria). Other studies show dogs can carry methicillin-resistant Staphylococcus aureus (MRSA) (111, 113, 114) after visiting human healthcare settings. Only, Lefebvre et al. (111) claim that CAIs in hospitals did not result in increased nosocomial infection rates of zoonotic infections.

When addressing zoonotic diseases, prevention protocols focus mainly on the dogs. The most common viral and bacterial zoonotic infections transmitted to humans by dogs are viral infections such as rabies and norovirus, and bacterial infections including *Pasteurella*, *Salmonella*, *Brucella*, *Yersinia enterocolitica*, *Campylobacter*, *Capnocytophaga*, *Bordetella bronchiseptica*, *Coxiella burnetii*, *Leptospira*, *Staphylococcus*

intermedius, *Streptococcus equi,* and *Methicillin-resistance Staphylococcus aureus* (114–118).

Animals always combine in a team with an animal handler, who may also carry zoonotic agents. In many guidelines, animal handlers are therefore presumed to follow the same rule as their animal; that is, not to visit their clients when displaying any symptoms of illness such as; fever, cough, diarrhea. Currently, humans are not required to have a yearly health screening from a physician or up-to-date vaccinations (49). The most reliable recommendation to safeguarding welfare and preventing the transmission of zoonotic disease is consistent hand hygiene and/or disinfection (25, 66, 82, 119) before and after visits and barrier protection such as linen disposal or changing the sheets on the bed after a visit (119). As animals often visit more than one setting, infection control tracking reports are also advisable (108).

Appropriate Behavior

CAIs would not exist without dogs. It is crucial to ensure clients' well-being and animal welfare (120). Canine body language (47) (e.g., gaze, yawning, lip-smacking etc.,) (29, 121) is widely used to assess animal welfare (122) however, there is a paucity of investigation regarding the impact of handling on the welfare of CAI dogs. Some physical interactions that humans enjoy during CAIs, are not always perceived as pleasant by dogs, such as physical intimacy with strangers, being restrained on the lap, teased with food or toys, kissed on the muzzle/face (123), or stared at in the eyes (85). Moreover, a small percentage of animals sustain injuries during CAIs (124, 125) due to clients' rough handling. These human behaviors may cause stress in the dogs, undesirable snapping (126), or even bites (127, 128). Bite wounds have a special position in traumatology due to the risk of complications. Antibiotic therapy for infected wounds, tetanus immunization status, and rabies infection risk are needed in bite wound management (129). Tetanus in dogs is thought to be uncommon (130). However, Burkitt et al. (131) show that when dogs develop severe tetanus, and younger dogs were significantly more at risk, the clinical course of the disease is similar to that of severely affected humans. A similar relationship has been identified in humans, in whom tetanus results in death most frequently among the young and the elderly (130, 132).

Research on proximal causality and (legal) consequences of dog bites in AAIs is needed as the possibility of a dog bite may increase if a dog is in/on the clients' bed and may be motivated through fear and/or anxiety (127, 133). Good training and welfare protocols as well as the presence of a handler mitigating for every scenario (134) will assist in avoiding bite incidents. The current guidelines of a minimum age requirement for CAI recognize that puppies may exhibit less predictable behavior, which poses an increased risk for bites, falls, or scratches. Some protocols advise clipping the dog's nails before every visit to avoid scratches (130, 135). Additionally, it may be required to undertake behavior and temperament assessments using tests designed to simulate the circumstances of working environments prior to starting

CAIs. Other guidelines request behavioral re-evaluation, every 2–3 years and/or the exclusion of certain breeds (e.g., trained guard-dogs, American Staffordshire terrier, Doberman pinscher) (49, 136). Currently, there is no empirical or epidemiological evidence to justify the required use of behavioral (re)tests, minimum canine age, or the exclusion of stipulated breeds in CAIs (40, 49).

Another welfare concern is the duration of CAI visits as sessions can vary from 15–120 min (31, 49). When more clients choose to attend sessions, the frequency of the interventions and the number of clients per session may increase, which can contribute to an increased workload, elevated stress levels in the dogs and possible undesirable behavior towards clients (31). In visiting programs, the transportation of animals might be a cause of elevated cortisol levels (137) and in residential CAIs where dogs and clients live together, clients may initiate an interaction at will, resulting in dogs being on duty 24 h/day with little time to rest (82). It is suggested that introducing a particular working-cue such as a bandana could help the dog to discriminate when the session starts.

CONCLUSION

As universal rules do not exist to provide for the welfare of dogs in CAIs, which might cause health issues for CAI participants, we reviewed literature to understand existing knowledge and propose a solution. Based upon the different aspects discussed in the previous section, we propose the Welfare Quality Model as a risk awareness tool to ensure safety in CAIs. The model provides insights into how dog management, health, behavior, and the environment in which dogs work during CAIs may influence participants' welfare and health. It is proposed that the Welfare Quality Model may serve in a broader professional context as a shared communication tool for veterinarians, practitioners, and physicians in streamlining multidisciplinary co-operation concerning CAI risk assessment and prevention procedures. The benefits of CAIs must outweigh the risks, therefore an enhanced understanding of the interaction between welfare and health is crucial.

AUTHOR CONTRIBUTIONS

LM and CD-G analyzed the literature. LM and EW did the draft preparation. This commentary emerged from conversations between all authors over an extended period of time. All authors were involved equally in conceptualizing the topic, approve the final version of the manuscript, ensure the accuracy and integrity of the work, and agree to be accountable for all aspects of the work.

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