



THE SCHOOL
OF PUBLIC POLICY

Master of Public Policy Capstone Project

Media Translation of Evidence Based Research: Vitamin D Portrayal in
Print Media

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Executive Summary

The goal of this capstone research paper is to explore how the media translates evidence-based research into recommendations for the public through an examination of how newspapers reported on scientific studies of the health benefits of vitamin D. Vitamin D is controversial because the medical community is still at odds on the proper dosage for preventing health care various conditions. That becomes a matter of public policy because vitamin D is sold without a prescription and is not otherwise controlled for consumer purchase and is taken at the public's discretion. Therefore, when news media translates research-based evidence on dosage (as well as other information), that translation directly influences the public's choices for how much vitamin D to take. When the media misses details or miscommunicates scientific evidence and conclusions, the public does not have the information required to make a fully informed health decision.

This paper explores six research reviews and corresponding media treatment of those reviews. Additionally, the paper includes discussion of several Cochrane Reviews on controlled clinical trials of vitamin D. Next , I conduct a news content analysis to compare the media's translation of the information from the scientific evidence. Finally, the capstone paper includes several public policy recommendations to encourage more accurate reporting of scientific evidence, in this area and others.

The main findings of this paper are that most news outlets fail to accurately portray a comprehensive overview of the scientific research. There were common issues, with



news articles missing scientific details, staying too close to their primary sources, and overemphasizing the conclusions they wished to forward while ignoring contrary information. Aside from the news articles, the scientific evidence indicates that very few conclusions can be drawn at present due to a lack of research. Most news articles did not note this important detail.

Introduction/Issue

There is potential in Canada for media sources to have important impact on citizens' health decision making. I explore that effect and provide insight on how the media, and newspaper in particular, reports on evidence-based research in its reporting. Using vitamin D as case study, this exploration will reveal issues in the print media's interpretation of health science evidence and presentation thereof.

Vitamin D supplementation (beyond food fortification) is of special interest because its use as a dietary supplement is largely self-regulated. There is no need to obtain a prescription for vitamin D and therefore there is no necessary medical oversight on its usage. This logically makes consumers more reliant upon media advice, as they do not have to pursue medical practitioners' opinions. When consumers are at the mercy of the media industry to determine usage, benefits, and adverse effects, they are susceptible to improper reporting.

That susceptibility becomes especially problematic if the media sources are not completely understanding or accurately reporting on the scientific research process or its conclusions and implications for vitamin D usage. The importance of media reporting as source of health information has been shown by sources such as the *Kaiser Health Poll Report Survey* (2005), which revealed that (40%) of adults relied on health care information from traditional media sources and only (20%) of adults who responded that they obtain this information primarily from doctors and other health professionals.

An Australian study (Li, Chapman, Agho, & Eastman, 2008) found that there had been a large scientific release on the benefits of dietary iodine in salt that spurred brief but

widespread media coverage. The Australian study found that iodized salt purchases increased 5.2% following this media attention. This example gives support to the idea that media informs and actively influences the population's health decisions.

When Canadians are not pursuing their health information primarily from medical professionals, there is the additional possibility of issue magnification. That is, the original consumers are more likely to pass their information on to family and friends and inaccuracies are spread and persist. Again, this issue is most concerning in non-prescription products such as vitamin D supplements since there is no medical advice to break the chain of information.

Hatfield, Sweeney, Lau, and Lichtenstein (2013) summarized the concerns with media and vitamin D supplementation in their critical assessment of major newspaper coverage in Canada and the USA. Their review analyzed those newspapers' coverage of vitamin D after the Institute of Medicine released revised dietary reference intakes for the vitamin and calcium. The release spurred a large increase of newspaper articles on the topic and Hatfield and colleagues reviewed those reports. They found that the coverage was inconsistent and incomplete, failing to comprehensively explain the recommendations and their implications. Notably, the reporters who had experience with the subject had a significantly higher number of sentences critical of the Institute of Medicine release, indicating that adequate critique of vitamin D research likely requires a degree of knowledge and experience beyond that of the average columnist.

The following paper will introduce both sides of the gap between scientific evidence and media coverage and seek to bring them together via public policy. It will begin with exploring six research reviews of vitamin D supplementation, followed by a

comprehensive overview of Cochrane Reviews, newspaper articles on the subject, and analysis of the media's coverage of the preceding scientific evidence. The paper will conclude with a public policy section consisting of several issues and proposed resolutions. Although the government cannot completely control media in Canada, I will recommend several policy procedures to apply quality control into Canadian health science news reporting. That degree of control could come from measures such as mandated scientific workshops and independent media review programs (an example can be found in Appendix 2, at the end of this paper). Those types of checks on the media would help to narrow the gap between for-profit newspapers and objective scientific study.

Methods

I have selected six reviews of vitamin D research that were published in 2013 and 2014. They are from well-respected international journals. I selected these particular studies because they were current and received media attention (they were the most-cited source in British Medical Journal and The Lancet). The reviews were addressed both by Canadian print newspapers and some international news outlets (such as the BBC and Science Daily). I originally intended to focus exclusively on Canadian print newspapers but expanded my media sources to well-known international news outlets that Canadian citizens are likely to use for health science information. In today's online reality, it would be unrealistic to expect Canadian to restrict themselves to their own nation's newspapers. However, I refrained from analyzing some international news outlets (such as the Washington Post, New York Times, etc.) so as to avoid a strong American news temperament.

I moved from the main six research reviews to the Cochrane Reviews Database for two reasons. Firstly, Cochrane is considered by scientists to be an objective resource for randomized controlled trial reviews. Secondly, those types of reviews are the ‘golden standard’ for clinical information because they provide causal evidence to support the correlative evidence from observational studies. Selecting Cochrane Reviews was a more complicated process than selecting the initial six reviews. I was not restricted to reviews getting media attention because, in fact, no news source I analyzed mentioned the Cochrane Reviews at all. However, I wished to give the reader a well-rounded scientific snapshot of the evidence surrounding vitamin D supplementation.

To begin, I searched the Cochrane Reviews Database with the broad phrase “vitamin D”, which resulted in approximately 163 results. I made review selections within eight specific categories that I felt were important to the average Canadian consumer of health science news on vitamin D: falls, pregnancy, kidney disease, skin conditions, multiple sclerosis, HIV, mortality, and miscellaneous distinct medical conditions. This resulted in approximately 44 reviews. I chose not to include reviews wherein vitamin D was an incidental intervention and not the primary point of research. I also chose not to include reviews wherein vitamin D serum concentration levels were the outcome of the study and not a primary intervention.

The table below is a summary of my findings from the six base studies and the Cochrane Reviews corresponding to them. A full exploration of the below is included in Appendix 1

Table 1: Detailed Description of Studies and Cochrane Evidence

	<u>Outcomes Studied</u>	<u>Subjects and Number of Subjects</u>	<u>Vitamin D dosage</u>	<u>Findings / Conclusions</u>	<u>Evidence from Cochrane Reviews</u>
Article 1 – Pregnancy and Vitamin D	Gestational diabetes, preeclampsia, bacterial vaginosis, Caesarean section, and birth variables (such as head circumference and infant length)	Pregnant women at all gestational ages and a range of ethnicities; more than 22 000 participants	Study focused on concentration, without dosage information; defined insufficiency at less than 75 nmol/L	Insufficient vitamin D associated with gestational diabetes, preeclampsia, and infants small for gestational age; also increased risk bacterial vaginosis and low birthweight infants	No effect on preeclampsia but <i>did</i> reduce the likelihood of having a baby weighing 2500 grams
Article 2 – Bone Mineral Density	Bone mineral density change from baseline, measured at 5 sites	4082 participants, 92% female, mostly white, average age 59	Range from less than 500 IU/day to over 800 nmol/day	Very small benefit at femoral neck site and no significant change elsewhere	One review that found a small effect of vitamin D supplementation for children, with a slight increase in the lumbar spine
Article 3 – Multiple Health Outcomes	Autoimmune diseases, cancer, cardiovascular conditions, cognitive disorders, infectious diseases, metabolic disorders, neonatal/infant/child related outcomes, pregnancy related outcomes, skeletal outcomes (including falls), and “other” – 137 outcomes in total	Not given; information provided was on number of studies, which totaled 107 systematic reviews and 74 meta analyses of observational studies	Dosage was not provided but range was large across the many studies and outcomes	Definite associations were found with rheumatoid arthritis activity, colorectal cancer, hypertension in children, bacterial vaginosis in pregnant women, falls in older people, and rickets in children; many outcomes had insufficient evidence	Very small positive effect for Multiple Sclerosis but not a comprehensive study of MS. Possible overall decrease in cancer mortality but not occurrence. Vitamin D was effective in reducing the rate of falls post-stroke but not risk of falling
Article 4 – Ill Health	Various; eight cancers: breast, prostate, oesophageal, ovarian, endometrial, bladder, kidney, and non-Hodgkin lymphoma. Also	Individuals aged 18 and over, 100 000 total; focused on Women’s Health Initiative	Dosage varied but studies after 2000 used dosage higher than 20 µg per day. The WHI trial used a daily dosage level of 10 µg vitamin D	Beneficial effect of vitamin D on 4% of the 91 endpoints, including colorectal cancer risk, insulin resistance and fasting glucose,	No cancer risk reduction, only reduction in <i>mortality</i> from various cancers. Small benefit in MS. Decrease in mortality across elderly

	infectious diseases, Parkinson's, cognitive function, and non-Alzheimer dementia, Multiple Sclerosis, elderly movement, and all-cause mortality.		and 1 g of calcium	some trials on mood and cognitive disorders, and some trials on physical functioning.	populations.
Article 5 – Skeletal, Vascular, and Cancer Outcomes	Multiple outcomes fitting within the categories of skeletal, vascular, and cancer-related	Close to 200 000 participants (no total given). Age ranged 53-85, mostly in the older range.	Not reported; studies focused on baseline concentration (72% began with less than 50 nmol/L)	Only hip fracture showed a possible change greater than the 15% futility level	Reviews on skeletal fracture found that vitamin D with calcium has a small effect on preventing hip fracture only. The Cochrane Review on cancer showed an overall reduction in cancer mortality but not incidence.
Article 6 – Cause Specific Death	Death from cardiovascular disease, cancer, and “other causes”	880 128 individuals, from Europe, North America, the Asian Pacific, and South America. The median participant age was 63	Differed in dosage between vitamin D3 and D2, with the former ranging from 10 to 6000 IU/day and latter from 208 to 4500 IU/day	Vitamin D3 given alone reduced mortality significantly by 11% but vitamin D2 showed no overall mortality effect	Cochrane review on mortality in general showed a decrease across elderly populations. The Cochrane Review on cancer showed an overall decrease on cancer mortality (but not occurrence).

Applying Base Studies and Cochrane to the Media

Pregnancy and Vitamin D Evidence

The Cochrane Review on pregnancy and vitamin D had some statistically significant effects on neonatal outcomes. The review showed no effect on preeclampsia but *did* reduce the likelihood of having a baby weighing 2500 grams (De-Regil, et al., 2012). Conversely, the base study conducted by Aghajafari and colleagues (2013) on maternal serum 25-hydroxyvitamin D level and pregnancy concluded that insufficient vitamin D levels *are* associated with preeclampsia, gestational diabetes, bacterial vaginosis, and infants small for gestational age (but no association with Caesarean sections, birth length, or head circumference). The study authors note that these effects are more beneficial for women from at-risk populations, including darker skin tones, higher latitudes, vegetarians, and those who wear protective clothing.

Pregnancy and Vitamin D Media

Paul Taylor wrote a news article for the Globe and Mail entitled “*Low vitamin D Levels Linked to Pregnancy Complications*” (2013). He suggested that the purpose for the study above was to determine appropriate dosage levels for pregnant women. He concludes that the study failed to find the appropriate dosage *but* that the researchers can safely conclude that pregnant women and their babies are at risk if the mothers allow themselves to become vitamin D deficient. He stated these risks and their percentage increases to be gestational diabetes (49% increased chance), preeclampsia (79%), bacterial vaginosis (187%), and babies smaller than normal weight (85%). Taylor notes that these issues begin once vitamin D levels go below 75 mol/L of blood. Balancing those statistics, Taylor acknowledges that it is too soon to make public health recommendations for

pregnant women and that the research only shows an association, not that vitamin D *causes* health risks. Taylor refers readers back to Health Canada recommendations for daily intake.

The CBC Canada website (2013) also posted a short piece on vitamin D supplementation during pregnancy. The piece concludes that there is a significant link between vitamin D insufficiency and several health risks but that more research is needed. The source also cautions that a multivitamin is likely not enough to ensure sufficient vitamin D.

Pregnancy Analysis

Both articles on vitamin D and pregnancy maintained a moderately objective tone. Taylor (2013) emphasizes statistics from the research that can be both alarming and are missing the complexities of the actual study results. That is, Taylor gave a cautious conclusion but included statistics drawn out of context. For instance, he notes an 85% increase in the risk of babies born smaller than the ‘normal weight’, without explaining what that means.

There are two problems with summaries such as this. Taylor did not include confounding factors and the complexities of the research data. Additionally, he used a different phraseology than the research itself, which only measured infant size for gestational age. For the average Canadian reader, ‘normal weight’ could mean an average of all infants (including both premature and to term), whereas ‘gestational age’ only measures based on a specific parameter.

Despite those issues, Taylor’s article had several positive characteristics. His analysis was objective and balanced and also discussed serum levels and a call for more research, details that some other columnists neglected. These conclusions are in line with the various Cochrane Reviews showing a lack of agreement on vitamin D within the medical

community. Paul Taylor was the Globe and Mail Health Editor from 1989-2013. He wrote dozens of health articles for the paper and has vast experience giving a balanced perspective on various important topics.

The very short CBC article (2013) accompanied an equally short video interview.

However, for the purposes of this analysis, I will be focusing on the print portion of the piece. Of course, without the video, there are some missing details in the conclusions drawn. However, the print concluded that there is a significant link between deficiency and health risks, which seems fair on the scientific evidence. It also notes that more research is needed, which is a good example of balancing the topic even in a very short article. However, the CBC notes that a multivitamin may not be sufficient vitamin D for pregnant women without giving any information on recommended daily intake, concentration levels, or even referencing the Health Canada guidelines. If a reader failed to watch the interview, this print article would lack a great deal of context and detail.

Bone Mineral Density Evidence

The Cochrane Reviews only examined vitamin D's effect on bone mineral density for specific at-risk populations, such as participants with CKD and HIV. There was one review that found a small effect of vitamin D supplementation for children, with a slight increase in the lumbar spine. Additionally, that study suggested that vitamin D may be useful for improving bone health in children who were already deficient (Geary, Hodson, & Craig, 2010). All Cochrane reviews urged for further bone density studies.

The study included in the first part of this paper conducted by Reid, Bolland, and Grey (2014) investigated vitamin D supplements and bone mineral density. Those authors found a very small overall effect of increased bone mineral density at the femoral neck and no effects on any other bone region. The authors suggest that vitamin D supplementation is unhelpful for the general population but may be beneficial for at-risk populations or those with a pre-existing deficiency.

Bone Density Media

Adriana Barton wrote an article for the Global and Mail, titled “Report questions effectiveness of vitamin D supplements” (2013). Barton’s main conclusion is that the low levels found in the above study on bone mineral density are a symptom and not a cause. Additionally, she says that vitamin D shouldn’t be taken for prevention as it does little to prevent bone loss unless, according to Barton, that risk exists already.

In her article, Barton points out that the connection between vitamin D and bone loss outcomes found in observational studies were not confirmed in the randomized trials by Autier, Boniol, Pizot, and Mullie (2014). She also referred to Ian Reid’s earlier study (Reid, Bolland, & Grey, 2014), which concluded that healthy adults do not need supplementation. Barton acknowledges that more research is needed, but says that taking vitamin D before then “remains a gamble”.

Also in the Globe and Mail, Margaret Wentz published the article titled “Why I Am Leaving the Vitamin D Church” (2013). Wentz looked at vitamin D in with other supplementations, calling the entire practice a pseudoscience. Wentz does not note that evidence is lacking before concluding that vitamin D does not improve health. She includes bone health density. Wentz refers to Ian Reid’s study and quotes him as stating

that healthy adults do not need vitamin D supplements. She makes the leap to say that vitamin D does not seem to improve bone density “or anything else”.

The health team at the BBC UK wrote “Vitamin D Pills’ Effect on Healthy Bones Queried” (2013). Referring to Ian Reid’s study, the BBC concluded that there are only benefits to giving vitamin D to deficient people. The article notes that Reid’s team found a small but significant increase in bone density but dismissed it as unlikely to be clinically significant.

This article by the BBC is unique in that the team brought in Doctor Tripkovic, who said that the study was too specific and noted lifestyle factors, genes, and the environment as possible confounding factors to affect bone density.

Bone Mineral Density Analysis

The three articles above generally focused too heavily on Dr. Reid’s statement, “our data suggest that targeting of low dose vitamin D supplements only to individuals who are likely to be deficient could free up substantial resources that could be better used elsewhere in healthcare” (Reid, Bolland, & Grey, 2014). Only the one article by the BCC (2013) recognized the fact that there was a significant effect of vitamin D on bone density. Because none of the articles included dosage or demographic information, they did not provide context for their conclusion. This leaves us wondering if the authors reasonably drew the conclusions, and if the readers will be able to understand them. For instance, Ian Reid’s study was conducted on mostly older white females. Additionally, dosage ranged from 500 IU per 800 IU per day. To understand the implications, the public should know those details

As noted by the BBC's expert, there are many confounding factors that make it difficult to draw a conclusion on vitamin D alone from one review. The other two articles failed to even bring this degree of balance to the issue. Most concerning, Wente (2013) expanded from this single study on vitamin D to deny *all* supplements. She dismissed all benefits of vitamin D, which is inappropriate regarding the relatively narrow scope of this study and ignores the lack of conclusive evidence shown in the Cochrane Reviews.

The BBC article did not give a specific author, which makes it difficult to determine the writer's health experience. The Global Mail articles did credit their authors. Barton generally does write on health topics; however, her articles are often trendy health issues that require more research. Wente is very successful and respected columnist. However, she largely writes on political issues and her aggressive tone seems less suited to a health topic.

Multiple Health Outcomes Evidence

The base study, headed by Theodoratou (2014), examined multiple health issues including autoimmune diseases, cancer, cardiovascular disease, cognitive disorders, infectious diseases, metabolic disorders, neonatal/infant/child related outcomes, pregnancy issues, skeletal outcomes, and others. The researchers found a definite association for only 8% of the clinical outcomes (six out of seventy). The outcomes were rheumatoid arthritis, colorectal cancer, child hypertension, bacterial vaginosis in pregnancy, falls in older people, and child rickets.

Several Cochrane reviews examined similar outcomes in a controlled review manner.

Studies on vitamin D and the autoimmune disorder of HIV found no statistically

significant effect of supplementation. The Cochrane review on Multiple Sclerosis (another autoimmune disease) found a very small positive effect of supplementation, but was not a comprehensive study of the disease (Jagannath, et al., 2010). One Cochrane review examined vitamin D supplementation in relation to overall cancer risk, but only included female participants and had a high attrition rate. That review found an overall decrease in cancer mortality but not in occurrence (Bjelakovic et al., 2014).

There were several Cochrane reviews on falls in elderly populations. One review did not show a reduction in the risk of falling or rate of falls but found a positive effect for elderly people who were already vitamin D deficient (Gillespie et al., 2012). Another study (Cameron et al., 2012) looked at falls in post-stroke victims. Vitamin D was effective in reducing the rate of falls but not risk of falling, findings that were repeated in one additional study, (Verheyden et al., 2013).

There was one Cochrane review on child rickets, which found a small effect of vitamin D preventing rickets but in a study with non-compliance (Lerch & Meissner, 2007).

Multiple Health Outcomes Media

CBC News Health Division posted an article entitled “Vitamin D No Magic Bullet, Review Concludes” (2014). The overarching conclusion of the article was that vitamin D seems ineffective at preventing multiple health outcomes, such as those examined in Theodoratou’s study. The article states that the review on multiple health outcomes shows that vitamin D is only associated with them, as opposed to finding a causal connection. Additionally, the piece suggests that the study should raise ‘alarm bells’ for readers, since vitamin D only shows a relationship to these outcomes in observational

studies and not randomized control trials. The author quotes Theodoratou's conclusion that highly convincing evidence of vitamin D's role does not exist, with only several 'possible associations' (Theodoratou, et al., 2014).

An article in Science Daily (2014) analyzed Theodoratou's study and concluded that there is still no clear evidence of a benefit of vitamin D on multiple health outcomes, "despite a huge number of studies". The piece acknowledges that Theodoratou's team looked at many health outcomes, and only found that ten of the 137 had been thoroughly tested. The article summarized that only one outcome (birth weight) had evidence of a benefit. This piece also cautions that the researchers found little evidence of a benefit for osteoporosis or prevention of falling.

Multiple Health Outcomes Analysis

The CBC news article has major issues with the mere 'associations' in the observational studies and cites only one review of trials with an apparent benefit but alleged bias and few patients. That is, the article focuses on one review showing a positive effect but obscured by bias, then ignores other available reviews with more stringent controls. The article could have been much more comprehensive of the issue as a whole. As shown in the Cochrane reviews on multiple health outcomes, there is other information available. The CBC piece mentions some details of the study, such as number of included outcomes. However, it failed to explore the definitions of "probable associations", upon which the article's main conclusion were based. In fact, the article states that there is no highly convincing evidence of a clear role of vitamin D, a provocative statement without definition of what 'highly convincing' looks like. Adding to the detail that was excluded from the article, the Theodoratou study found a 'definite association' for 8% of the

included outcomes, which can have an impact at the population level (Theodoratou, et al., 2014). Finally, the researchers could not obtain sufficient data to reach a conclusion for 60 of the included outcomes (just under half). The CBC does not address either of these contextual details.

The CBC article does not address vitamin D supplementation for at-risk populations, which was a recommendation of the study based on randomized clinical trials. This conclusion is both supported by causal evidence and important to health at the population level. Additionally, neither the CBC article nor the Theodoratou study addressed dosage for vitamin D. This is, in fact, the issue at the root of most of these studies and the articles analyzing them. The absence of dosage information precludes readers from drawing a nuanced conclusion with the issue's entire context.

No author was provided for the CBC article, not allowing for analysis of the writer's expertise on the subject or health writing in general.

The Science Daily (2014) article essentially concluded that, of 137 possible health outcomes, there was only thorough evidence for 10. However, the piece fails to note that Theodoratou's study actually found a 'definite association' for 8% of the outcomes. This type of association can only be concluded from observational studies but certainly counts as evidence of a relationship with vitamin D. It would have been more accurate for the article to note the difference between observational and randomized controlled trials and to give a more detailed statement on which type was lacking and what they both indicate. Secondly, as noted above, Theodoratou's team noted that 60 outcomes had inconclusive evidence (Theodoratou, et al., 2014). This fact was not addressed by either the CBC or Science Daily and would have given a better context to the Science Daily statement that

clear evidence had not been found. In fact, Theodoratou's study showed that *barely any* evidence had been found, either showing or negating a causal relationship between vitamin D and multiple health outcomes.

As with the CBC article, the Science Daily piece did not cite authorship so did not allow for analysis on that factor.

Ill Health Evidence

The main study on ill health examined many outcomes, including eight cancers. The authors found a decreased colorectal cancer risk, decreased disease aggression and extent for breast and prostate cancers and cutaneous melanoma with vitamin D. The researchers found an inverse relation between infectious diseases and vitamin D supplementation. Low vitamin D concentration was related to higher frequency of mood disorders. One study also showed a decrease in relapse and disability for Multiple Sclerosis. Studies on all cause mortality showed a general association (Autier, et al., 2014).

The Cochrane Review on vitamin D and cancer did not show a reduction in cancer risk, only in mortality from various types of cancer (Bjelakovic, et al., 2014). There were no Cochrane Reviews on infectious diseases or mood disorders and vitamin D. The review on vitamin D and MS showed a small benefit (Jagannath, et al., 2010). The Cochrane review on vitamin D and mortality showed a decrease in mortality across elderly populations (Bjelakovic, et al., 2014) which supports the study above.

Ill Health Media

The National Post ran an article entitled "Vitamin D Supplements Offer No Benefit to Healthy Individuals, Study Finds" (2013). The main conclusion of this piece was that there are no benefits to supplementing vitamin D for healthy people because low serum

levels are a symptom of their ill health and not a cause of it. The article acknowledges that observational studies showed a correlation between vitamin D levels and ill health (cardiovascular disease, lipid concentrations, glucose levels, weight gain, infectious diseases, and mood levels) but cautions that random trials showed little or no effect. The article notes that Autier, Boniol, Pizot, & Mullie's study (2014) showed virtually no benefit to supplementation beyond the very minimal level required for bone health. The article discusses concentration levels, stating that guidelines recommend supplementation below 30 nanograms per milliliter of blood but notes that Autier said skeletal risk only occurs below 10 nanograms. Additionally, the article briefly mentioned dosage in Autier's study, summarizing that it varied but was generally above 800 IU.

The BBC (2014) also ran an article on Autier's study, concluding that supplements of vitamin D are only useful for certain groups. The piece stated that ageing and disease actually *decrease* vitamin D concentrations and that this is the only reason a wide range of disorders shows a deficiency. The BBC article quotes Autier as attributing the decreases in vitamin D to ageing, inflammation, and ill health. The BBC notes that Autier's study did not examine bone disease so declines to draw a conclusion on that outcome. For other ill health outcomes, the article summarizes that observational studies suggest benefits but that randomized trials negate those suggestions, even if the participants originally had low vitamin D levels. However, the BBC notes that vitamin D supplementation has historically improved bone health, preventing hypercalcaemia and rickets.

Ill Health Analysis

The National Post article (2013) was fairly balanced and included such contextual details as concentration levels and dosage, as well as differentiating between observational studies and randomized controlled trials. However, the piece drew recommended blood concentration levels from the Canadian Guidelines and then contradicted those recommendations with Autier's statement that only minimal dosage levels for bone health are useful. For an article in a national newspaper to contradict the established health guidelines, that statement must by nature be thoroughly researched and concretely backed by the evidence. In fact, Autier's study varied greatly in obtained blood concentrations so his statement should properly be taken as a personal opinion based on summary. The data simply does not support such a drastic decrease from the Canadian Guidelines.

Similarly, the National Post article draws conclusions on the effectiveness of vitamin D without acknowledging a need for further research. Autier himself pointed out this requirement, as did nearly every other researcher and columnist included in this paper. The National Post has therefore not given context to its conclusions and has created the danger that the readers will consider this a completed science, preventing further research on their parts before discontinuing vitamin D supplementation. In fact, the Autier study found some indication of effect with several types of cancer and a large inverse association with mortality risk. The National Post discredited such observational findings and called for more causal evidence (a lack of evidence that was evident in the lack of Cochrane Reviews). However, it determined that there was a reverse causal relationship, with ill health leading to vitamin D deficiency. That is a logical error; if there is not enough causal evidence, then that applies to both directions of causation.

The National Post article did not include authorship information, which would give evidence of the writers' experience.

The BBC (2014) article on vitamin D and ill health improved on the National Post article by recognizing the need for future research. Additionally, this writing acknowledged the inverse associations found in observational studies, a detail the National Post missed.

Though the article went on to then negate those relationships in clinical trials, the high percentage of risk reductions in the observational studies should flag the readers that there may be more to this story.

The piece recognizes that Autier's study did not analyze bone health but proceeded to make comments on that topic with an expert's statements. Due to the position of the comments on bone health, it may seem to a reader as though the BBC is connecting those conclusions to Autier's study. As the writers themselves note, that would be a fallacy.

Similarly to the National Post article, the BBC piece states that there are insufficient randomized trials for a causal conclusion but then repeats Autier's statement that ageing, inflammation, and ill health *cause* low vitamin D levels. Again, this is illogical.

Finally, the BBC article also did not provide an author's name.

The population from Autier's study was mostly drawn from the Women's Health Initiative, with most participants being female and mostly given a dosage of 10 μ . The National Post and BBC both failed to include this information. They did not give a full contextual analysis of the study and how it may translate to the general population (which, of course, also includes men and children).

Skeletal, Vascular, and Cancer Evidence

The study conducted on skeletal, vascular, and cancer outcomes found that the vitamin D effect on risk of death is uncertain but found a 4% reduction in risk when vitamin D was combined with calcium. The statistical significant risk reduction in this study was defined at 15% reduction, which may have excluded some effects of vitamin D supplementation. The authors found that vitamin D and calcium together decreased hip fractures by 16% but found some statistical issues with that trial (Bolland, Grey, Gamble & Reid, 2014). The Cochrane Reviews on skeletal fracture found that vitamin D combined with calcium has a small effect on preventing hip fracture only (Avenell, Mak, & O'Connell, 2014). As noted above, the Cochrane Review on cancer showed an overall reduction in cancer mortality but not incidence.

Skeletal, Vascular, and Cancer Media

Carly Weeks of the Globe and Mail wrote a story on vitamin D entitled “New Study Fuels Debate About Benefits of Vitamin D” (2014). She held the position that low vitamin D with various health conditions is not a causal relationship, merely a correlative one. Weeks’ recommendation was that vitamin D should not be taken as a preventive measure (even for fractures) but does urge for more rigorous future studies. She points out that it is extremely difficult and unrealistic to isolate vitamin D in bone studies from the effects of eating well and exercising.

Weeks referred to Bolland’s study on vitamin D and cancer, multiple sclerosis, heart disease, and various other conditions. She quotes him, saying there is little justification for prescribing preventive vitamin D supplementation for healthy people in the community. The article explained the difference between observational and clinical

studies and pointed out that the studies finding benefit with vitamin D were largely observational, only supporting a correlative relationship.

The BBC Health team published an article titled, “Vitamin D Not Needed for Healthy People, Study Finds” (2014). The article concludes that, since vitamin D does not decrease disease risk past the 15% threshold amount, there is little reason to prescribe it to healthy adults as a preventative measure. According to the BBC, vitamin D may have a role but it is not an important one and only clinically useful for at-risk populations.

The article referred to hip and other fractures, heart disease, stroke, cerebrovascular disease, cancer, and risk of death, none of which were reduced by 15% in the study. The research team summarized their findings as showing little justification for widespread supplementation and suggested that the country maintain a cautious approach to vitamin D supplements until there is more information.

Marlene Busko authored a Medscape article titled “Future Trials Unlikely to Support vitamin D Supplementation” (2014). This article looked at the outcomes of myocardial infarction, stroke, cancer, or hip fractures in seniors. Busko notes that vitamin D did not reduce the risk of any of these outcomes by 15% or more. Although she reasons that vitamin D may reduce the risks by lower percentages (by 5% perhaps), she quotes Bolland saying that the take-away message gives little justification for supplementation to prevent those outcomes in the community.

That conclusion is for healthy people, as Bolland recognized that frail elderly people in residential care, people with deeply pigmented skin, and those who avoid the sun might require supplements. Busko cites Bolland by saying that the body of evidence is

‘sufficiently large’ that the conclusion will likely not be changed by future research. The article notes that high vitamin D dosage may increase risk of fractures and falls so calls for stringent policies on supplementation.

Skeletal, Vascular, and Cancer Analysis

Carly Weeks wrote a fairly balanced article and pulled in external sources such as The National Cancer Institute, Health Canada, and the Institute of Medicine. However, she failed to explain the originating study’s 15% risk reduction threshold. This arbitrary cutoff for relevance is important because it may obscure smaller but still significant reductions in risk. The original study indicated that vitamin D taken in conjunction with calcium may reduce hip fractures at or beyond the 15% futility boundary but the sequential analysis indicated some uncertainty.

Weeks acknowledged that Canada requires more research to reach a conclusion on vitamin D supplementation and the health outcomes, a recommendation supported in the Cochrane Reviews. Though Weeks does not make a dosage recommendation due to lacking evidence, the article mentions the Health Canada guidelines for dosage. That is useful to give context to her exploration. Weeks has written for The Globe and Mail since 2007. She writes on a broad range of topics but mainly public health policy. This indicates that she has the background knowledge to understand some of this study’s complexities.

The BBC article was fairly dismissive of vitamin D supplements for healthy adults. The article mentioned the 15% risk reduction threshold but did not explain its implications and limitations. The article merely repeated the researchers’ conclusions that the study has demonstrated little reason for supplementation. The BBC brought in two experts to

further explain the study, Dr. Michaelsson and Dr. Michie. The former cautioned that we need more evidence to draw clinical conclusions and to make recommendations for or against vitamin D supplementation. This opinion helped to balance out the study and give context to the complex issue. The BBC followed that statement with one by Dr. Michie, claiming that vitamin D may have a role but not an important one. He supports dietary vitamin D maintenance.

These opinions are problematic because Dr. Michaelsson is acknowledging that the issue is not concluded, whereas the researchers and Dr. Michie's opinions on the study are that vitamin D supplementation has little use and that that conclusion will not change. Finally, the BBC article had a small but significant mistake. It opens by introducing a review of "more than 100 trials". In reality, however, the study at hand only examined 40 trials. At more than twice the actual amount, the BBC's mistake makes the study seem much more impactful and conclusive. Additionally, mistakes such as these may indicate that journalists may not fully understand research design and reports.

Busko's Medscape article was certainly the most balanced of the three and best represented the study itself as well as the complexities surrounding vitamin D supplementation. Most importantly, Busko adequately explained the limitations of the 15% risk reduction threshold and the clinical effects it may exclude. Despite her grasp of those implications, she still maintained Bolland's 'take away message', that there is little justification for vitamin D supplementation. This is problematic because Busko has recognized that the study has integral flaws but proceeds to parrot its conclusions. Other than that issue, Busko wrote a well-balanced exploration with correct trial numbers, dosages, and Dr. Michaelsson's external opinions. She discussed Dr. Michaelsson's

cautions with high vitamin D doses, which may increase the risk for fractures and falls.

Busko was the only columnist to mention these adverse effects and they add complexity to the issue but, without evidentiary support, may have an alarmist effects for readers.

Marlene Busko is an experienced editor for Medscape, with a long resume of health articles. This may explain why her writing caught implications of the study that the other columnists missed.

Bolland's study itself mentioned extremely varying dosage levels, to which none of the articles above referred. Additionally, many of the trials that Bolland analyzed did not have the relevant outcome as their primary endpoint. This can mean that the data was not the main focus of the study and possibly was subject to lower levels of scrutiny. All of the columnists above failed to mention those limitations.

Cause Specific Death Evidence

The study included above on cause specific death found that vitamin D supplementation does not reduce overall mortality in a statistically significant manner. However, observational studies showed that an inverse relationship might exist between vitamin D concentration levels and cause specific mortality for multiple outcomes. The authors note that only vitamin D3 was effective and not vitamin D2 (Chowdhury et al., 2014).

The Cochrane review on mortality in general with vitamin D supplementation showed a decrease across elderly populations, as noted above. Also as already noted, the Cochrane Review on cancer showed an overall decrease on cancer mortality (but not occurrence).

Cause Specific Death Media

Science Daily posted an article titled "Still no clear evidence for health benefits of vitamin D? Experts try to make sense of the data" (2014). The piece analyzed two papers

from the British Medical Journal, the second of which was based on the cause specific death study included in this paper. The authors note that, although there have been many studies into the health impact of vitamin D supplementation, there is still insufficient evidence for a clinical benefit. The article mentioned the outcomes of death from cardiovascular disease, cancer, and other conditions. Science Daily noted that the study found an association between low circulating vitamin D serum levels and those mortality risks. The article called for more clinical research into dosage, the difference between vitamins D2 and D3, and other factors on mortality risk.

Cause Specific Death Analysis

The Science Daily article gave a well-balanced and explained perspective on vitamin D supplementation and its effect on cause specific death. The main flaw in this article is the absence of external information sources; Science Daily stayed very closely aligned with the British Medical Journal paper and the study itself. However, the Science Daily article did an excellent job of indicating limitations in the study, such as the elderly participants and the fact that cause-specific death was not typically the primary outcome for the trials. The article calls for more clinical research on specific issues such as dosage, safety, and which form of vitamin D, which enables future clinical trials to be much more targeted and fill the gaps in vitamin D research. It may have been useful to explain the difference between a causal relationship and an association in the article, as well as to give some more background information on vitamin D2 versus vitamin D3. This would have better educated the readers and equipped them to supplement themselves more safely.

Additionally, while the article calls for more clinical trials. In our exploration of the Cochrane Reviews, we also noted the lack thereof. Lastly, the article also does not cite an

author so readers are unable to analyze the drafter's expertise and background knowledge.

Limitations of the Above Analyses

The biggest hurdle for this capstone analysis was that there is a small amount of evidence or media available so the sample size is limited. The media coverage was not extensive but gave an overall impression of how Canadian newspapers are interpreting the scientific evidence of vitamin D. Of course, as noted above, that evidence is itself extremely limited and the researchers themselves are calling for further study.

Secondly, there is another issue that went beyond the scope of this paper. When the media writes on a scientific study, they generally do so from a press release. This is a condensed version of the scientific study and its conclusions. Those releases are generally not made public so I could not analyze their effect. More importantly, these releases not peer-reviewed. This means that researchers have the capability to put emphasis on certain results or implications of their study, leaving room for bias in the attempt to 'hook' the media's interest. It would be interesting to examine the possible influence created by these press releases.

Policy Recommendations

As noted above, Canadian citizens rely heavily on the media to make medical decisions in general, and to determine their vitamin D supplementation in particular. If the media is not reporting upon this issue in a scientifically correct and comprehensive manner, the citizens are incapable of making informed decisions about their health.

The above exploration has revealed several issues in the media's handling of the science surrounding vitamin D supplementation. I will focus on the following issues in my policy

recommendations: reporters are missing details and do not seem capable of selecting those that are important, reporters do seem to fully appreciate or understand the research process and overstate the science, media sources seem to be framing the issues in the most controversial manner possible, and there are no currently effective means of regulating the accuracy of vitamin D reporting.

Due to the media's important role in Canadians' health decisions about vitamin D supplementation, these issues are extremely troubling and present a problem for public policy. In the following, I will propose reasonable recommendations that will attempt to minimize these issues. Below is an in-depth explanation of my policy recommendations, of which there are three: scientific workshops or conferences for health science journalists, greater framing oversight on the part of the Canadian Association of Journalists, and finally a fully independent health science news review system.

Educate reporters on the primary research process because they are missing details and don't seem to know what's possibly important

Many journalists enter their field with a Bachelor of Arts degree in journalism. This holds true even for science journalists who write the stories on health that influence the entire country's behaviour. In fact, a recent survey of science journalists in Canada revealed that only 20% of the group obtained a Bachelor of Science degree, which would afford the most basic tools to analyze complicated health research. When journalists without science degrees at the University of British Columbia were asked if they had received any special training to compensate for their education, 10 of the 25 had received nothing and only 8 attended science courses (Fong, n.d.).

These numbers are concerning because they indicate that the vast majority of science journalists do not have science degrees and, of those journalists, most of them receive no additional training. This lack of training manifests itself in missing important details such as dosage, duration, and the difference between observational and clinical studies. These issues arose in the articles analyzed above, as well as the overemphasis on clinical studies and devaluation of observational studies.

Additionally, health science reporting seems to adhere too closely to the primary source and its main conclusive statement without looking for alternatives. This can result in ‘overstating the science’, a problem when the research is nowhere near conclusive but the media portrays it as such, ignoring information surrounding and mediating the main conclusion. Additionally, this is a problem when articles fail to include secondary and contradictory sources. As stated by Caulfield, Clark, McCormack, Rachul & Field (2014), leaders in this field, in their review in the British Medical Journal, as many as 65% of newspaper articles do not provide details beyond the conclusion. They mentioned details such as type of study, sample population, and size. These scientific details can greatly influence the effect of a study’s conclusion.

Even before scientific evidence reaches the media, it can be extremely complex and difficult to draw conclusions without a fully contextual analysis. For instance, there was recent confusion on the topic of aspirin and whether the medication had a curative effect on colorectal cancer. The vast majority of observational cohort- and control observational studies indicated that regular aspirin or NSAID (with no difference between the two) were consistently associated with a reduced risk of colorectal cancer. This association

was found especially after use for 10 years or more and only with 300 mg or more of aspirin per day (Flossman & Rothwell, 2007).

The medical community tested this association in clinical trials; however, many of the trials found null results. Scientists doubted the efficacy of aspirin. Recently, randomized controlled trials were conducted over longer durations, more in line with the durations of the observational trials. These tests found a causal relationship, with aspirin reducing the risk of colorectal cancer (Rothwell et al., 2010).

This example of confusion, even in the scientific community, demonstrates how essential it is to understand the importance of study duration and dosage. Perhaps most importantly, this serves to demonstrate that observational trials still hold value for scientific evidence, despite the longstanding belief that clinical trials are the ‘gold standard’ of testing. If researchers themselves are capable of mistaking this value, it seems likely that news reporters also require additional scientific training to grasp such subtle complexities and their implications.

There are two immediately obvious routes to resolve this issue: require science journalists to have science degrees *or* compensate for the lack thereof with additional training. As stated by Helen Fallding, a Science graduate writing for the *Winnipeg Free Press*, “We need more people with science backgrounds to go into journalism. I’m not sure, that after the fact, you can take a journalist with no science background and train them to do it very well”. However, it would be unreasonable to require science journalists to obtain a Bachelor of Science. Canadians may study whatever they like and apply that knowledge in whatever way they see fit. However, it may be a very valuable endeavor to encourage

Science students to pursue a journalistic career. That may not be a current focus in science programs and would address the issue, at least to a degree.

In many cases, it may not be feasible to obtain a scientific technical background. In those situations, it is entirely reasonable to require science journalists to obtain additional training for the tools they require to write on scientific public health issues. That would at least help the reporters to understand the studies and details thereof that they are undertaking to analyze. For instance, and as noted by a Hamilton reporter in the Science Journalism Research Group, "... in the United States there are a large number of health organizations that do provide workshops for reporters and I don't think there's as much of that in Canada" (Fong, n.d.).

One of these workshops is run by the US National Cancer Institute and focuses on cancer research in the media and how science journalists should address scientific study on that issue. A Canadian alternative is the journalist workshop program through the Canadian Institutes of Health Research ("Events," 2015). This is a government-run program, funded by tax dollars. These types of workshops educate health science journalists on the current trends, as well as general knowledge of science research and the analysis thereof. The value of these conferences cannot be understated, with reporters able to ask questions and obtain the building block to inform the Canadian public.

I would recommend that the Canadian government create a more comprehensive training program with sessions for health science reporters. This would be similar to social workers and nurses, who have to complete regular professional development to maintain their standings. Although journalists are not required to have mandated accreditation, the completion of this program could be noted in their bylines. This will provide an

indication of expertise and incentive to complete the program. This additional training would not infringe upon the journalists' freedom of expression rights. They would still be able to express the opinions they choose but would have more appropriate tools to do so.

**Train media away from framing the issue in the most controversial manner,
changing them from the reporter mode to educator mode**

When journalists 'frame' an issue, they present their information to the audience in a manner that indicates to their reader how to process the information. As noted in an exploration of framing theory, one website states that journalists "not only tell the audience what to think about [...] but also how to think about that issue" ("Framing Theory," n.d.). The framing method manifests in vitamin D newspaper coverage with journalists determining how to present the evidence from their subject research. As pointed out in the analysis above, the majority of the articles framed their evidence in a negative tone, suggesting that vitamin D supplements do not have a benefit to healthy individuals. Although some of the journalists mentioned that the research is far from complete and even more noted that certain populations still need supplements, this overwhelmingly negative framing made those details less obvious.

As noted by Timothy Caulfield, one of the framing issues in vitamin D media coverage is that "media often frame vitamin D and supplementations in terms of the health benefits of vitamin D for everything". As the above research analysis revealed, that is simply not how vitamin D operates. Its effect is different on different conditions *and* different populations, and even at the individual consumption level. This conclusion oversimplification is an element of framing and the media has been presenting a catchall answer that does not reflect the science.

Gary Schwitzer echoed this opinion in a review in BioMed Central. He analyzed the web-based project called Health News Review, of which he is one of the founding members. This web-based health news-rating program (“Health news review,” n.d.) evaluates health science articles. I will explain more about their system momentarily but will focus on the BioMed review here. That review summarized the Health News evaluations and found several concerning themes in what Schwitzer calls “medical misadventures”. The web-based project found that many of the articles framed benefits in the most positive light “by using relative risk reduction statistics without the corresponding risk reduction numbers”. Note that, in the above analysis of Canadian articles, there were no risk reduction numbers supplied. Schwitzer mentions several other framing issues within American health news articles, including presenting single source stories absent of conflicts of interest as final conclusions. His concern with framing in the USA certainly applies to many Canadian articles as well.

According to a paper analyzing environmental coverage in Canada called “Mass Media and Policymaking”, media framing has two main and troublesome implications. News sources (and newspapers in particular) frame issues so as to sell more copies and gain a wider audience. As that paper notes, this leads to two framing implications. Firstly, news media does not consistently report on an issue, even if the evidence surrounding it changes slightly. It is much more likely for media to only report on matters that have caught the public’s immediate attention, which does not stay on one subject for long. Secondly, news sources may not always have a balanced perspective as their main goal. Newspaper especially may pursue the more controversial headline to sell more copies, even if that headline does not lead to the best-evidenced story or scientific study.

The paper gives as an example the Canadian coverage on climate change. That coverage generally remains minimal until after a substantial weather change or environmental event. This pattern translates to vitamin D coverage. As noted by Timothy Caulfield, vitamin D news stories increased in frequency in 2010, which he connected to the release of the revised vitamin D recommendations by the Institute of Medicine in that year.

Possible remedies to the framing issue are less obvious than to the health science problems. My above-proposed training workshops and sessions would help remedy some of this negative treatment and oversimplification of the scientific evidence. However, issue framing is in many ways more a journalistic art than a health science one.

Therefore, I would propose that the journalism industry take responsibility to remedy this issue. Of course, newspapers in general wish to make profit and conclusive, one-sided headlines tend to do a better job of that.

The Canadian Association of Journalists has its own Ethics Guidelines, a document of operations for writers. The guidelines include values such as fairness and accuracy but I would recommend that they should additionally require responsible framing. This would be a more difficult area to monitor than something like scientific accuracy. However, the association may use the network of Canadian journalists to hold each other accountable anonymously. When this system fails (as many peer-reviewed systems do), the Association should have the power to require individual media sources (i.e. the Globe and Mail) to hold frame-working workshops and ensure their writers are operating to a responsible standard.

Make the scientists themselves more accountable for translating the research into public information

I have demonstrated above that Canadian news coverage on vitamin D supplementation shows weaknesses in both the journalists' understanding of the scientific process and its implications, as well as framing issues that naturally flow from the newspaper medium's coverage of health topics. I have recommended some solutions to fix those isolated problems but my main public policy proposal aims to preserve the integrity of health news reporting in Canada as a whole, and on vitamin D in particular.

The Health News Review (HNR) is mentioned above in the framing section but I will expand upon it here. An American web-based program, the HNR is headed by Gary Schwitzer and is a rating program for health science reporting. This program is superior to a peer review system because it is free of the bias that would be caused by journalistic loyalty and protectionism. Additionally, this type of independent rating program is a better option than a government-headed one, since it does not run the risk of infringing upon the Charter of Rights and Freedoms-protected freedom of expression.

The HNR employs a team of about 40 reviewers, all of who have vast experience in the health sector and many of who have clinical backgrounds. All of the reviewers are educated in the medical science field and most have a Masters or a PhD. Several journalists with years of health science writing round out the team. Every reviewer for HNR signs an industry-independent disclosure agreement to ensure no conflicts of interest and completely unbiased and objective reviews. As mentioned, Gary Schwitzer heads this team.

The HNR monitors many news sources and evaluates recent news releases that include a claim of efficacy about specific treatments, tests, products, or procedures. The HNR

began reviewing in 2006 and now evaluates American newspaper leaders in daily circulation, the NPR, websites of television networks, websites of news magazines, as well as stand-alone websites such as Vox.com, Slate.com, and Buzzfeed.com. The HNR began reviewing television health news daily but found that was not cost-effective and now generally reviews television as a group of media sources. The project is funded by public donation through a University of Minnesota foundation and does not appear connected to the American government *or* to journalists in America.

The HNR operates on a star rating system. The amount of stars a news release receives is based on ten objective factors. Each 20% increase in score on the ten factors results in an additional star. That is, 0-20% gives a one-star rating, 21-40% gives two stars, and so on up to five stars at 81-100%. The ten factors were developed from two publications:

“Coverage by the News Media of the Benefits and Risks of Medications” and “Statement of Principles of the Association of Health Care Journalists”. This second source is similar to the Canadian Association of Journalists Ethic Guidelines but is specific to health care writers. It is an international body so can be applied to Canadian systems as well.

According to the HNR website, the ten factors correspond to what consumers need to know to make an educated decision about their healthcare and are analyzed by two or three of the qualified reviewers per story. The factors are as follows:

Does the story adequately...

1. Discuss the costs of the intervention;
2. Quantify the benefits of the treatment, test, product, or procedure;
3. Explain/quantify the harms of the intervention;
4. Grasp the quality of the evidence;

5. Commit disease-mongering;
6. Use independent sources and identify conflicts of interest;
7. Compare the new approach with existing alternatives;
8. Establish the availability of the treatment, test, product, or procedure;
9. Establish the true novelty of the approach; and
10. Appear to rely solely or largely on a news release?

It may be obvious that several of the above factors are issues that this paper identified in several of the Canadian news releases on vitamin D. According to the HNR website, approximately 70% of American media misses the first costs element in each day's news. Additionally, many stories over-emphasize the positive benefits and ignore potential harms, especially while failing to recognize the limits of current evidence. This last issue is a massive problem in vitamin D reporting, with skews to clinical reviews only and many stories failing to mention the need for more research. To summarize, the HNR evaluates health news on parameters that would be extremely applicable to vitamin D reporting in Canada, as well as health reporting generally.

While the rating system is extremely useful and translates well to the issues discussed in this paper, they are not an effective public policy measure unless they are put to use. The HNR employs these ratings in two ways: they email the results to the journalists responsible for the evaluated material and also post the ratings on <http://www.healthnewsreview.org/>. The website gives a very comprehensive breakdown of the story's evaluation and tells consumers why the articles' shortcomings or successes are important. This way, consumers are completely informed while reading both that story and also others on similar topics. Additionally, the journalists who wrote the stories

are able to access feedback on what they did wrong and how they can improve future health science coverage. An example of a slightly altered rating example on vitamin D stories is provided in Appendix 2.

I would suggest that Canada could benefit greatly from a rating system similar to the Health News Review. The site operates smoothly and gives information on the issues with health news reporting that I have identified above. There is only one barrier to a Canadian Health News Review repairing the problems in Canadian health reporting and that is accessibility. If Canadians do not know the system exists, its efficacy is null.

A Health News Review system cannot place ratings directly on the articles themselves for multiple reasons. Firstly, the news stories have already been published when they are open to review. Secondly, if the program requires stories to be reviewed *before* they can be published, that would greatly damage the independence of Canadian journalists and their ability to voice their opinions freely.

There is, however, another way to ensure that Canadians know of the project's existence and know where to find the information to make their health decisions. The Canadian Health News Review would have to advertise their services, benefit, and location. If this system is kept practically separate from the Canadian government and media's influence, it could theoretically advertise itself as an independent body for the Canadian people.

This means that it could run magazine ads in health publications, as well as television advertisements targeting interested demographics, or radio commercials to access a wide variety of people. Additionally, the review system could be presented to the journalists attending the workshops/conferences I have recommended above, for the education of

Canadian health news providers. Writers and consumers alike should be broadly aware of this system for it to have educational *and* preventative value.

Of course, increased advertisement comes with increased funding requirements. Those would be in addition to the funding required to run the program itself. The HNR in the USA has a team of 40 researchers, which is funded by public donations to the University-run foundation. In Canada, a similar system could be employed but expanded upon to cover the increased advertisement costs.

I would propose a three-pointed funding program. The public donation system would be preserved and run through a similar anonymous University foundation. Additionally, the Canadian Association of Journalists would pay a yearly amount to the review program. This may seem counter-intuitive, as the ratings would inevitably damage the reputation of some journalists. However, the Canadian Association of Journalists touts professional integrity as part of its mandate and would, by this rating system, become renowned for integrity in health reporting. Finally, Health Canada, a division of government, would also pay a yearly fee that closely matches the Canadian Association of Journalists' amount.

By creating this trio of funding, with representations of journalists themselves, government, and the affected public, bias should be eliminated. All interested parties would be involved in bankrolling the project but *no* interested party shall be involved in operating it. That is, an independent individual like Gary Schwitzer and a similar team shall run the Canadian Health News Review. In Canada, I would propose an individual such as Timothy Caulfield, who has impressive health news and medical science experience, the respect of the industry, and a position at a leading Canadian science

university. Someone such as Timothy Caulfield could create this type of team and project at the University of Alberta

Appendix 1

Reviews

Article 1 - Association between maternal serum 25-hydroxyvitamin D level and pregnancy and neonatal outcomes

Aghajafari et al. (2013) ran this study, which explored the association between maternal serum vitamin D level and pregnancy and neonatal outcomes. The research team included both randomized controlled trials and observational studies; however, the bulk of the data was from the latter. The researchers searched Medline from 1966-August 2012, PubMed from 2008-August 2012, and EMBASE from 1980-August 2012, and CINAHL from 1981-August 2012. Additionally, they included the Cochrane database of registered clinical trials. The study results were published in March 2013.

The review included 31 studies, ten of which were on gestational diabetes, nine on preeclampsia, three on bacterial vaginosis, two on Caesarean section, and ten on birth variables. One study included more than one outcome. The number of participants in the included studies ranged from 95 to 1100, with more than 22 000 women participating in total. The review included a comprehensive range of ethnicities and gestational ages.

The review design included a definition of vitamin D insufficiency. The studies varied in their own definitions so the researchers combined those various cut offs to reach a defined insufficiency at less than 75 nmol/L. For birth variables, the review defined insufficiency at less than 35.5 nmol/L. The authors wished to ensure those definitions did not exclude studies so, where necessary, used the cut offs reported in the studies themselves. The concentration cut-offs for the studies varied widely, including anywhere

from 20 nmol/L up to 80 nmol/L, with a large number using 37.5, 50, and 75 nmol/L as reference points. Dosage was not a focus of this review.

The main findings of this review are that insufficient vitamin D levels are associated with gestational diabetes, preeclampsia, and infants who are small for their gestational age.

Pregnant participants with low levels of 25OHD also had an increased risk of bacterial vaginosis and low birth weight infants but there was not a demonstrated association with Caesarean sections, birth length, or head circumference. The authors conclude that, “[their] review, summarizing existing data, shows an increasingly compelling case for a causal relation between low 25-OHD levels and adverse maternal and neonatal outcomes.”

The stated implications of this review are more significant for women from specific groups, such as with darker skin tones, those in colder climates or higher latitudes, those who wear sunscreen and protective clothing, and vegetarians. The researchers suggest that these women would benefit from vitamin D supplementation. Though the review makes that recommendation, the authors also note that there is active debate on appropriate dosage and did not comment on what dosage would be most effective.

The limitations of this review include confounding factors, which reduced the quality of some of the studies. One example, given by the authors themselves, was that maternal nutrition was not controlled across studies and greatly affects birth weight. In addition, the studies were mostly case-control in design, which creates the potential of an over-exaggerated size effect. Also, all but one of the studies were from developed countries, creating a lack of information about the vitamin D needs in underdeveloped nations. As

noted above, definitions for sufficiency varied among the studies. Finally, dosage was not included in this review or its implications.

Article 2 - Effects of vitamin D supplements on bone mineral density

This study, entitled “Effects of vitamin D supplements on bone mineral density: a systematic review and meta-analysis”, was conducted by Reid, Bolland, and Grey and was published in October 2013. The review examined all randomized controlled trials that investigated vitamin D and mineral bone density published from inception to July 8, 2012. The researchers drew these studies from Web of Science, EMBASE, and the Cochrane Database. This review only investigated studies with subjects who had no other metabolic bone diseases; that is, without others conditions likely to affect bone mineral density or metabolism. The researchers included studies that did not specifically have vitamin D impact as their endpoint. Twenty-three studies met the inclusion criteria, which included 4082 participants, mostly female (92%) and mostly white. The average age of participants was 59 years old. The bone mineral density endpoint was defined as the percentage change from the baseline. The density was measured at one to five sites. When dosage for the studies was averaged, 500 IU per day or less was given in six studies (n=1648), 500–799 IU per day in four studies (n=646), and 800 IU per day or more in 13 studies (n=1788). The concentration for the study results showed a mean concentration of less than 30 nmol/l in 5 studies (n=1860), 30-50 nmol/l in 3 studies (n=6), 50-75 nmol/l in 11 studies (n=1860), and more than 75 nmol/l in one study (n=186). In twelve studies, calcium was also administered to all groups. Seventy tests of statistical significance were performed across all of the 23 studies. There were only six studies showing a significant benefit to vitamin D supplementation. Two

studies showed detriment and the remaining studies showed no significant change. The overall results showed very small benefit at the femoral neck and *no* effects at the other sites were noted. The results indicate that high dosages of vitamin D are not needed to achieve bone density, as the highest dosage group did not show higher bone density. The implications of the analysis are that vitamin D supplementation is not warranted for skeletal protection of the general population. Vitamin D can be beneficial for individuals with risk factors or pre-existing deficiency.

There are several limitations to the studies in this review: they examined mostly white women of an older age (generally post-menopausal). The study concluded its findings with the statement, “Our data suggest that the targeting of low-dose vitamin D supplements only to individuals who are likely to be deficient could free up substantial resources that could be better used elsewhere in healthcare.”

The researchers noted that they employed the Cochrane Reviews in their search for data. However, there is no evidence as to how much of that database was included in the final study.

Article 3 - vitamin D and multiple health outcomes

Theodoratou, Tzoulaki, Zgaga, and Ioannidis published this study in April 2014. The review focused on both observational and clinical trials, including systematic reviews, meta-analyses, or both. The researchers examined a wide range of outcomes including autoimmune diseases, cancer, cardiovascular conditions, cognitive disorders, infectious diseases, metabolic disorders, neonatal/infant/child related outcomes, pregnancy related outcomes, skeletal outcomes (including falls), and “other”.

The study included 107 systematic literature reviews and 74 meta-analyses of observational studies of plasma vitamin D concentrations and 87 meta-analyses of randomized controlled trials of the vitamin with 137 outcomes. Both meta-analyses of observational studies and randomized controlled trials examined ten outcomes. Data was collected from Medline and EMBASE from inception to 11 October 2013.

The researchers classified their findings into levels of evidence of association and applied those categories to each outcome. The levels of evidence ranged from inconclusive (insufficient evidence) to no association, to suggestive (possible) association, and finally to a definite association. They applied these levels of evidence to each category of their studies.

The researchers found a definite association between vitamin D and only six (8%) of the 76 clinical outcomes. Those outcomes were rheumatoid arthritis activity, colorectal cancer, hypertension in children, bacterial vaginosis in pregnant women, falls in older people, and rickets in children. The researchers found a lower risk for all of these outcomes associated with higher vitamin D concentration than baseline (though exact concentrations were not provided). Ten outcomes fit within the 'no association' category. The researchers were unable to reach a conclusion regarding 60 of the outcomes and the data was inconclusive for a conclusion for 43 outcomes. For a small number of outcomes (17), researchers concluded that an inverse association was possible or suggestive. However, no systematic reviews drew a definite or suggestive association for *increased* risk with higher vitamin D concentration.

The implications of these main results are that vitamin D supplementation may not be as useful as previously thought in preventing both osteoporosis and falls in elderly

populations. However, randomized trials do note that there is some use for vitamin D supplementation in specified populations such as children, pregnant women, and patients with chronic kidney disease. However, the researchers insist that recommendations about daily intake cannot be made without further evidence and contextual information regarding an individual's absorption rate, body mass index, disease, as well as specific outcome.

There are several significant limitations to this review. First and foremost, the review does not refer to concentrations or dosage levels of vitamin D. Moreover, the researchers do not give information as to participant number, demographics, or duration of the 23 studies included. Without that information, it is difficult to form a conclusion on association level.

The study summarizes with the following statement:

Despite a few hundred systematic reviews and meta-analyses, highly convincing evidence of a clear role of vitamin D does not exist for any outcome, but associations with a selection of outcomes are probable.

In conclusion, although vitamin D has been extensively studied in relation to a range of outcomes and some indications exist that low plasma vitamin D concentrations might be linked to several diseases, firm universal conclusions about its benefits cannot be drawn.

The researchers do mention Cochrane Reviews, but in a specific manner. They refer to two studies, both of which support their own conclusions. However, there is no reference to studies that contradict their conclusions or that suggest that further evidence is needed.

Article 4 – vitamin D Status and Ill Health

In this review, Autier, Boniol, Pizot, and Mullie examined vitamin D status and ill health. The report was published in December of 2013. The researchers examined both observational and randomized controlled trials. In total, there were 290 prospective cohort studies (with 279 of those on disease occurrence and the other 11 on cancer) and 172 randomised control trials. To locate those studies, researchers searched PubMed and EMBASE from inception to December 31, 2012. They focused on individuals aged 18 and over. The researchers did not include trials with other supplements or medications given with vitamin D, except for calcium. Additionally, there were no studies included in the review that tested vitamin D-enriched food.

The researchers included studies on many various outcomes, with a range of results. The data from meta-analyses and pooled analyses suggested no association between vitamin D levels and eight cancers: breast, prostate, oesophageal, ovarian, endometrial, bladder, kidney, and non-Hodgkin lymphoma. However, the authors noted a decreasing colorectal cancer risk associated with increased vitamin D level. Additionally, the researchers found no significant association between vitamin D level and survival from lung, head, or neck cancer; conversely, there was an inverse correlation between vitamin D level and disease aggression and extent for breast and prostate cancer, as well as cutaneous melanoma.

Studies examining vitamin D and infectious diseases (6) suggested an inverse relation between the vitamin D levels and disease frequency and severity. There were five studies on mood disorders, all of which showed an increased disorder frequency with low vitamin D. Similar results were listed for Parkinson's, cognitive function, and non-Alzheimer dementia. The authors note a decreased risk of relapse and disability for higher vitamin D level in studies of multiple sclerosis but another source showed no

association. Half of the studies on the physical movement of the elderly showed an association with higher vitamin D levels but the other half did not. Studies on all-cause mortality showed a general association, with a meta-analysis reporting a 29% decrease in mortality with higher vitamin D and 15 other studies showing significant decreases as well. Two other studies not included in the meta-analysis did not show such decreases. The authors included five studies using composite endpoints that included all-cause mortality. Those studies showed similar results to the meta-analysis.

This review examined a meta-analysis which included 100 000 total patients. The dosage for the studies therein varied, but those after the year 2000 generally used dosage higher than 20 µg per day. This review focused on the Women's Health Initiative, as it was the largest trial done on vitamin D supplementation. That trial used a daily dosage level of 10 µg vitamin D and 1 g of calcium for 84 months. In 72% of the 153 non-Women's Health Initiative studies, the mean vitamin D concentration level exceeded 72 nmol/L.

The review of the meta-analyses only indicated a beneficial effect of vitamin D on 4% of the 91 endpoints included. There were three for HOMA-IR (insulin resistance) and one for fasting plasma glucose. Trials examining tuberculosis and infectious episode healing showed null results. Two of the seven trials examining mood and cognitive disorders indicated improvement with vitamin D but five had null results. For physical functioning, trials showed mixed results. Eleven trials of proximal leg strength and seven of grip strength did not show a supplementation benefit. Three other trials showed positive results for thirteen endpoints.

Of six included trials on high vitamin D dosage for multiple sclerosis patients, none showed an effect on any clinical endpoint. Studies examining all-cause mortality showed

that vitamin D supplementation could reduce the risk of all-cause mortality but the authors note that the studies were performed almost exclusively on elderly women living in institutions. The results may therefore be limited.

In general, the observational studies in this review showed some possible associations between vitamin D level and clinical endpoints. However, the clinical trials did not support those associations for the most part. Because the observational studies were not causal, it is possible that the vitamin D level did not have a direct effect on the endpoint but was merely a symptom of the inflammatory processes of the disease. This conclusion implies that vitamin D supplementation should not be recommended; at the very least, it should not exceed recommended daily intake levels.

The authors of this review note that some of the studies may not have been of unimpeachable quality, but do not go into detail on why. Additionally, the concentration levels obtained during the clinical trials varied greatly, which may have had an effect on the conclusions and even possibly masked some effects that may have been possible at higher concentrations.

Article 5 – The effect of vitamin D supplementation on skeletal, vascular, or cancer outcomes

Published in January of 2014, this study examined the effect of vitamin D supplementation on several outcomes. The researchers were Bolland, Grey, Gamble, and Reid. The outcomes fit within the categories of skeletal, vascular, and cancer-related. The researchers obtained data from PubMed from January 2009 until January 31, 2013. In addition, the authors reviewed the recent reports from the International Agency for Research on Cancer, the Institute of Medicine, and the Endocrine Society. The review

included only randomized controlled trials, using 44 reports of 40 individual trials.

Additionally, the researchers obtained unpublished data for two trials from calcium supplement meta-analyses but the groups used in the review only differed in vitamin D levels.

Of the 40 trials, 80% reported baseline vitamin D concentration levels, with 72% of those having lower baseline levels than 50 nmol/L. Of the 40 trials, 34 reported vitamin D levels on treatment, and 31 of 32 reported numerical increases from the baseline, and 30 of those (94%) reported vitamin D levels greater than 50 nmol/L after treatment.

The authors of this review determined a 15% risk factor decrease as significant, requiring vitamin D to reduce the risk of the endpoint by 15%. Anything below that level fell within a 'futility boundary'. The authors note that the effect of vitamin D on risk of death is uncertain (though note that traditional meta-analyses suggest vitamin D and calcium together may reduce the risk of death by up to 4%). vitamin D supplementation with or without calcium fell within the futility boundary for ischaemic heart disease, stroke, cerebrovascular disease, cancer, total fracture, and hip fracture. That means that vitamin D supplementation with or without calcium did not decrease the risk of those outcomes by 15% or more.

For vitamin D and hip fracture, there is some indication that vitamin D co-administered with calcium *may* bring the effect above the futility boundary. However, that effect was only evident in two trials with institutionalized patients who were elderly women with low baseline vitamin D and calcium. In the meta-analysis, vitamin D and calcium together decreased hip fracture incidence by 16% but trial sequential analysis threw uncertainty on that value.

The authors summarize their conclusions by writing, “our findings suggest that vitamin D supplementation with or without calcium does not reduce skeletal or non-skeletal outcomes in unselected community-dwelling individuals by more than 15%”. The implication of this conclusion is that there is no significant benefit to widespread vitamin D treatment. Additionally, the authors note that further trials will likely have similar results.

There were several significant limitations with this review. Firstly, the 15% risk factor threshold is practically high. In effect, a risk reduction of less than 15% could make vitamin D supplementation worthwhile at the population level. Secondly, the authors note that many studies did not have the outcomes included as their primary endpoints. When using secondary endpoints, there is a risk of data being subject to lower scrutiny levels. Lastly, dosage level of vitamin D was extremely variable and measured daily, per week, and per year. This variation can make it difficult to generalize a conclusion.

Article 6 – vitamin D and Risk of Cause Specific Death

This article, published in April 2014 by Chowdhury et al., examined vitamin D and cause-specific death, as opposed to all-cause death. The researchers gathered data from Medline, EMBASE, the Cochrane Library, and reference lists of relevant studies from inception to August 2013. The review included both observational cohort studies and randomized controlled trials in adults. There were 95 unique study reports within the inclusion criteria, comprising of 880 128 individuals and 71 625 mortality outcomes. The review included participants from Europe, North America, the Asian Pacific, and South America. The median participant age was 63. Twenty-two of included studies were randomized controlled trials reporting on isolated vitamin D effect on mortality

outcomes. The average age in those trials ranged from 56 to 85 years old. Eleven trials included participants' community-based registers but the others were from clinical registers. The studies differed in dosage between vitamin D3 and D2, with the former ranging from 10 to 6000 IU/day and latter from 208 to 4500 IU/day.

The results of the randomized controlled trials indicate that, given alone, vitamin D may not reduce overall mortality in a significant way in the adult population. However, observational studies indicated an inverse relationship between vitamin D level and cause-specific mortality for all outcomes (cardiovascular disease, cancer, and other causes). When the data was segregated into type of vitamin D, vitamin D3 given alone reduced mortality significantly by 11% but vitamin D2 showed no overall mortality effect. The authors of this review wrote the following concluding statement:

Supplementation with vitamin D3 reduced overall mortality significantly among older adults; however, before any widespread supplementation, further studies will be required to determine the optimal dose and duration and to reliably establish whether vitamin D3 affects the mortality risk differently than vitamin D2.

There are several implications of this study. Because the randomized controlled studies showed some benefits of D3 supplementation, that type of intervention might be used to prevent cause-specific death. There may be public value, especially for the elderly population, obese individuals, and also individuals with lower than optimal sun exposure. The authors of the review note that further research is needed before conclusions are drawn on the appropriate dosage to reach the benefits of vitamin D3.

There are several limitations with this review; the studies were almost exclusively performed on elderly individuals, though many of them were living in the community. The authors note that observational studies do not provide evidence of direct or indirect associations. Additionally, individual vitamin D levels vary from day to day and with absorption rates so the authors of this study request that future research attempt to correct that inconsistency.

Cochrane Reviews

Fracture:

1. *“Vitamin D and vitamin D analogues for preventing fractures in post-menopausal women and older men”* (Avenell, Mak, & O'Connell, 2014).

Vitamin D was ineffective in preventing hip fracture or any new fracture. However there is some evidence that vitamin D combined with calcium may have a small effect in reducing hip fracture only. Additionally, there is significant evidence that vitamin D supplementation combined with calcium has a risk reducing effect on any fracture type. The study also noted a possible adverse effect of vitamin D and calcium. This was an increase in gastrointestinal symptoms but no increased risk of death.

The review included 53 trials, with 91 791 participants. Thirty-one of these examined vitamin D with and without calcium in the community or hospital settings. Twenty-two smaller trials examined calcitriol or alfacalcidol in hospital settings. For most trials, the dosage of vitamin D ranged between 400 IU and 1100 IU daily, with most at the higher end of that range.

2. *“Nutritional Supplementation for hip fracture aftercare in older people”* (Avenell & Handoll, 2010).

Vitamin D supplementation did not have an effect on the examined outcome, which was the healing of hip fractures in hospitalized older people.

The study included 24 trials, with 1940 participants aged 65 and older, with recent hip fracture. Vitamin D dosage was extremely low.

Falls

1. *“Intervention for preventing falls in older people living in the community”* (Gillespie et al., 2012).

The review examined various interventions to reduce falls in older people, one of which was vitamin D. The researchers found that vitamin D did not reduce the rate of falls or risk of falling. However, there may be some effect for these who are deficient before treatment. The study included 16 trials, with 29,002 participants that examined vitamin D or analogue, with or without calcium. Vitamin D dosage ranged between 200 IU and 1000 IU

2. *“Interventions for preventing falls in older people in care facilities and hospitals”* (Cameron et al., 2012).

Vitamin D supplementation was effective in reducing the rate of falls but not the risk of falling. The review included 60 trials, with 60,345 participants in clinical settings. Five of these trials focused on vitamin D supplementation and one on a multivitamin containing vitamin D and calcium. Vitamin Dosage ranged between 200 IU to 800 IU daily. Another review, *“Interventions for preventing falls in people after stroke”* (Verheyden et al., 2013), found similar results in 85 participants who were hospitalized post-stroke with low vitamin D levels.

Pregnancy

1. *“Vitamin D supplementation for women during pregnancy”* (De-Regil, Palacios, Ansary, Kulier, & Peña-Rosas, 2012).

Vitamin D supplementation combined with calcium had no effect on preeclampsia; however, vitamin D supplementation alone reduced the risk of having baby weighing less than 2500 grams. The review included 6 trials, with 1023 women. The preeclampsia trial gave a dose of 1200 IU daily with calcium. The rest of the trials administered close to 1000 IU daily of vitamin D.

Kidney Disease

Children

1. *“Interventions for bone disease in children with chronic kidney disease”* (Geary, Hodson, & Craig, 2010).

This study examined different preparations of vitamin D and their effects on the bone health of children with chronic kidney disease (CKD). The researchers found that all forms of vitamin D improved PTH levels, which are an indication of bone disease. The

study included 15 trials, with 369 children. Vitamin dosage for these studies were not measured in IUs but dosage ranged between 10 to 20 ng/kg/d.

Adults

2. *“Vitamin D compounds for people with chronic kidney disease not requiring dialysis”* (Palmer et al., 2009a).

Vitamin D supplementation reduces PTH levels significantly in adults with kidney disease who do not require dialysis. However more research is needed to understand if the found effect is caused by vitamin D itself or its effect of increasing calcium and phosphorus levels. Whether directly or indirectly, vitamin D supplementation reduces PTH levels. Additionally, there was no change in mortality or the need for dialysis. The review included 16 studies, with 894 patients. Vitamin D dosage varied wildly, supporting the main results across dosage levels. A similar study conducted by the same researcher (2009b) found similar results in patients requiring dialysis (“*vitamin D compounds for people with chronic kidney disease requiring dialysis*”).

3. “*Interventions for preventing bone disease in kidney transplant recipients*” (Palmer, McGregor, & Strippoli, 2007).

This review examined treatment with bisphosphates and vitamin D and calcitonin. All three increased bone density at the lumbar spine, while only the first two had a positive effect at the femoral neck. Although the study mentioned adverse effects, they were infrequent.

The review included 24 trials, with 1299 patients. For most trials, vitamin D dosage ranged between .2 to 0.5 ug/d.

4. “*Intervention for treating Sexual dysfunction in patients with chronic kidney disease*” (Vecchio et al., 2010).

Researchers found no evidence to support vitamin D supplementation to treat sexual dysfunction as a result of CKD. They acknowledged, however, that this maybe due to extreme sparse data.

Skin Conditions

1. *“Interventions for actinic keratosis”* (Gupta, Paquet, Villanueva, & Brintnell, 2012).

This review examined 83 trials including 18 topical creams or gels, used by 10,036 participants. All trials showed less effectiveness than photodynamic therapy, with vitamin D cream having no effect. It is worth noting that only one study addressed vitamin D and that withdrawal rate for all studies was high.

2. *“Dietary Supplements for established atopic eczema”* (Bath-Hextall, Jenkinson, Humphreys, & Williams, 2012).

Vitamin D, as well as other supplements, does not show evidence of a positive effect on eczema. There were 2 trials that examined vitamin D; both with and without vitamin E. vitamin D dosage ranged between 1000 IU and 1600 IU.

MS

1. *“Vitamin D for the management of MS”* (Jagannath, Fedorowicz, Asokan, Robak, & Whamond, 2010).

This was a very small review that looked at one trial with 49 participants. The researchers found a slight indication of a positive effect on vitamin D on MS. they noted that a realistic conclusion cannot be drawn without more data.

HIV

1. *“Micronutrient supplementation for children with HIV infection (Review)”* (Irlam, Siegfried, Visser, & Rollins, 2013) and 2. *“Micronutrient supplementation for children and adults with HIV infection”* (Irlam, Visser, Rollins, & Siegfried, 2010) and 3. *“Interventions for the treatment of decreased bone mineral density”* (Lin & Rieder, 2007).

The first review examined several interventions with only one trial on vitamin D, including 59 participants. Researchers found no statistically significant effect of vitamin D on HIV. However, they note that more evidence is needed to draw conclusions. A similar review on children only found almost identical results. Additionally, one study included vitamin D's effect on bone mineral density with HIV. That evidence showed a benefit but only if patients also received alendronate and calcium.

Mortality

1. *“Vitamin D supplementation for prevention of mortality in adults”* (Bjelakovic, Gluud, Nikolova, Whitfield, Wetterslev, Simonetti, Bjelakovic, & Gluud, 2014).

This review indicates that vitamin D3 decreases mortality across elderly population, whether in community or clinical settings. This effect was seen in all 56 trials with 95,286 participants. The participant age ranged from 18 to 107 years old, with most participants older than 70 and 77% of them women. Conversely, vitamin D2 had no statistically significant effects on mortality. The researchers acknowledged the need for more research on younger healthy participants.

Miscellaneous Conditions

Adults

1. *“Vitamin D supplementation for cystic fibrosis”* (Ferguson & Chang, 2014).

This review included 6 studies with 239 participants but only 3 studies gave data on cystic fibrosis. The first study looked at one single dose of vitamin D of 250,000 IU. The second study examined participants given 800 IU supplemental vitamin D daily and compared them to a placebo group, with both groups continuing 900 IU of vitamin D

daily. The third study compared three groups, taking 1600 IU vitamin D daily alone, taking it with one gram of calcium, and taking one gram of calcium alone. The researchers mentioned three outcomes from the studies: serum levels increased significantly, bone marrow density had no significant change, and no studies showed adverse effects. However, the researchers note that no recommendation can be made regarding vitamin D supplementation for cystic fibrosis until more data is available.

2. *“Vitamins for Epilepsy”* (Ranganathan & Ramaratnam, 2009).

This review included 15 studies; one of which had 226 participants and showed significantly increased bone density after vitamin supplementation. No studies gave evidence that vitamin D supplementation reduced seizure occurrence. Vitamin dosage was 2000 IU per day for 3 months. The researchers cautioned that all of the studies were of poor methodological quality and that more studies are needed.

3. *“Vitamin D supplementation for prevention of cancer in adults”* (Bjelakovic, Gluud, Nikolova, Whitfield, Krstic, Wetterslev, & Gluud, 2014).

The review included 18 randomized controlled trials, or RCT's, who were mostly females in developed rich countries (50,623 participants). The age range was from 47 to 97 years old. Vitamin D administration (D2 or D3) lasted for an average of 6 years and dosage level varied.

Researchers found a decrease in all cause mortality and cancer related mortality. However, there was no firm evidence that vitamin D supplementation increased or reduced cancer *occurrences* in women living in community dwellings. The author noted that the above results should be taken with caution due to type one error, which resulted from large of participants leaving the study before completion (attrition rate)

4. *“Vitamin D and calcium for corticosteroid-induced osteoporosis”* (Homik et al., 1998).

This review included five RCT studies with 274 patients who took both vitamin D and calcium for 2 years. The vitamin D dosage varied between 400 IU per day and 50,000 IU weekly, which averages to just over 7000 IU per day. The trials showed that bone density of the lumber spine and forearm improved after taking vitamin D and calcium. The treatment was safe but showed no effect on other outcomes.

5. *“Intervention for latent autoimmune diabetes (LADA) in adults”* (Brophy, Davies, Mannan, Brunt, & Williams, 2011).

This review included 15 studies but only one examined vitamin D interactions with insulin to stabilize fasting C-peptide levels, a measurement of LADA aggression. Compared to the insulin group, vitamin D supplementation for 12 months steadied these levels. The study included only 35 participants so more evidence is needed to draw firm conclusions for LADA.

6. *“Nutritional supplements for people being treated for active tuberculosis”* (Sinclair, Abba, Grobler, & Sudarsanam, 2011).

This review included 23 trials but only 4 focused on vitamin D supplementation; two looked at daily vitamin D compared to a placebo, one compared 3 high doses of 100,000 IU to a placebo, and last study compared 4 high doses of 2.5 mg vitamin D to a placebo. The researchers found no significant effect on death, cure, or treatment completion. There

were some evidence of adverse effects, which were mild hypercalcaemia and worsening of tuberculosis abscesses.

7. “*Vitamin D for the treatment of chronic painful conditions in adults*” (Straube, Derry, Moore, & McQuay, 2012).

The review included 4 studies with 294 participants. Of the four, only one study showed an effect on the consumption of analgesics and anti-inflammatory medicines, with those consumed much less frequently than in control groups. However, that study had a dosage of 100 000 IU per day for 12 months. Although this result is positive on its face we need more evidence of an effect and proper dosage.

Children

8. “*Bone density in children*” (Geary, Hodson, & Craig, 2010).

This review included 6 studies with 343 participants and investigated the effectiveness of vitamin D supplementation in healthily children and adolescents (aged one month to 20 years old). The dosage of vitamin D given to participants varied, and as a result authors categorized a “high dosage” as 200 IU or higher per day. Vitamin D serum levels achieved after supplementation also varied; authors considered anything below 35 n/mol as low and anything over 35n/mol as high.

The trials revealed that vitamin D supplementation had no effect on total body bone mineral content, hipbone density or forearm arm bone density. However, the study revealed that there was a small effect on the lumbar spine. Also, the researchers noted that vitamin D supplementation may be effective in improving bone health in children who are deficient in vitamin D but more research is needed.

9. “Interventions for the prevention of nutritional rickets in term born children” (Lerch & Meissner, 2007).

This review included four studies, with 1700 participants. The vitamin D dosage ranged between 133 IU to 370 IU daily. Despite the non-compliance of some trials, there is evidence of a vitamin D preventative effect on rickets. This effect is especially beneficial in young children. One study in particular showed a significant risk reduction of rickets.

Appendix 2	1	2	3	4	5	6	7	8	9
Pregnancy									
1: Paul Taylor (Globe and Mail)	X	✓	X	✓	✓	X	X	X	X
2: CBC Canada Post	X	✓	X	X	✓	X	✓	X	X
Bone Mineral Density									
3: Adriana Baron (Globe and Mail)	X	✓	X	✓	✓	✓	X	X	✓
4: Margaret Wentz (Globe and Mail)	✓	X	X	X	✓	✓	X	X	X
5: BBC UK	✓	✓	✓	X	X	✓	X	X	✓
Multiple Health Outcomes									
6: CBC News	✓	X	✓	X	X	X	X	X	✓
7: Science Daily	✓	X	X	X	✓	✓	✓	X	X
Ill Health									
8: National Post	X	X	X	X	✓	X	X	X	X
9: BBC	X	✓	X	✓	X	✓	✓	✓	✓
Skeletal, Vascular, and Cancer Outcomes									
10: Carly Weeks (Globe and Mail)	X	✓	✓	✓	X	✓	X	X	✓
11: BBC Health Team	X	X	X	X	X	✓	X	X	✓
12: Marlene Busko (Medscape)	✓	✓	X	X	✓	X	X	✓	✓
Cause Specific Death									
13: Science Daily	✓	✓	X	✓	✓	✓	X	✓	✓
<u>Totals (out of 13):</u>	6	8	3	5	8	8	3	3	8
<u>%</u>	46	62	23	38	62	62	23	23	62

The above is an example of a Canadian Health News Review table, tailored to the included articles on vitamin D. The article received a checkmark if it satisfied the journalist requirement noted, which are as follows:

- 1: mentioned costs of intervention
- 2: included benefits
- 3: mentioned harms
- 4: grasp quality of evidence (i.e. observational versus clinical)
- 5: did not perform disease-mongering or fear-mongering

- 6: included conflicts of results or need for more research
- 7: free of framing issues or of overemphasizing most controversial implication
- 8: included most of the important contextual details
- 9: included research sources other than the primary source

The conclusions from this small-batch analysis are as follows:

- 1: 46% sufficiently mentioned costs of intervention
- 2: 62% included benefits
- 3: 23% mentioned harms
- 4: 38% grasped quality of evidence (i.e. observational versus clinical)
- 5: 62% did not perform disease-mongering or fear-mongering
- 6: 62% included conflicts of results or need for more research
- 7: 23% free of framing issues or of overemphasizing most controversial implication
- 8: 23% included most of the important contextual details
- 9: 62% included research sources other than the primary source

As indicated in the above capstone paper, the largest issues with this sample of vitamin D media coverage (focused on newspapers relevant to Canadians) shows a pattern. The columnists had difficulty grasping the quality and implications of scientific evidence, in particular the difference between and value of observational versus clinical studies. Additionally, there were prevalent framing issues. Most journalists employed controversial language and titles. Our study also found that there was a huge absence of important and technical contextual details. Finally, although there was about 62% inclusion of benefits, calls for further research, and sources other than the primary study, those were almost exclusively just mentioned. When those elements were included, they were not explained or were made to seem inconsequential in light of the negative framing.

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