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Nutri-Score, Warning Signs, and Facts Up Front – In Theory and In Practice A Comparative Analysis of the Effectiveness of Front-of-Package Labeling Systems

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A Comparative Analysis of the Effectiveness of Front-of-Package Labeling Systems

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Abstract

Suboptimal diets contribute significantly to poor health and chronic diseases, with excessive sodium intake and low consumption of whole grains, fruits, and vegetables being major risk factors. To address this global nutrition burden, various countries have implemented front-of-package labeling (FOPL) systems such as the Nutri-Score, Warning Signs, and Facts Up Front.

This paper aims to analyze the effectiveness of these systems – which vary in development, design, content, and implementation – in both theory and practice. The methodology involves a comparative analysis of three FOPL systems, assessing their theoretical effectiveness with international guidelines and practical effectiveness through expert interviews and secondary data.

Findings show that while both the Nutri-Score and Warning Signs generally adhere to international guidelines, the Nutri-Score faces more divisive consensus, while the Facts Up Front label lacks in several crucial areas. The three systems have varying degrees of academic, industry, and government support, with the voluntary, non-interpretive Facts Up Front label being most preferred by the industry and less supported by research, whereas the vice versa applies for the government-mandated, interpretive Warning Signs label, and the voluntary, interpretive Nutri-Score garners both support and dissent from all stakeholders.

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Dr. Julia, your intelligence and passion for improving nutrition standards were evident throughout our conversation, and I learned so much about the Nutri-Score in such a short amount of time — I probably took over 10 pages of notes during our interview! Thank you so much for your dedicated commitment to helping students.

Dr. Thrasher, go Gamecocks! Thank you for an insightful interview. I had never considered the interaction of the U.S. food industry and the tobacco industry on front-of-package labeling. It was also interesting to learn about the spillover effects of Mexico's warning labels on the U.S.

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Mr. Gaberell, I love how Public Eye tells stories in such an informative yet digestible way, and our interview mirrored the accessibility of the article. I understood the intricacies of industry and government interactions much more thoroughly. Thank you for a wonderful conversation.

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Table of Contents

I. **Introduction** ---------- **5-7**

II. **Methods** ---------- **7-9**

III. **Literature Review** ---------- **9-13**

A. **Nutri-Score** ---------- **9-11**

B. **Warning Signs** ---------- **11-12**

C. **Facts Up Front** ---------- **12-13**

IV. **Analysis** ---------- **13-34**

A. **International Guidelines and Policy Frameworks** ---------- **13-15**

B. **Principles of Development** ---------- **15-19**

1. Nutri-Score Development ---------- 15-16
2. Warning Signs Development ---------- 16-18
3. Facts Up Front Development ---------- 18-19

C. **Principles of Design** ---------- **19-24**

1. Nutri-Score Design ---------- 19-21
2. Warning Signs Design ---------- 21-22
3. Facts Up Front Design ---------- 22-24

D. **Principles of Content** ---------- **24-29**

1. Nutri-Score Content ---------- 24-26
2. Warning Signs Content ---------- 27-28
3. Facts Up Front Content ---------- 28-29

E. **Principles of Implementation** ---------- **29-34**

1. Nutri-Score Implementation ---------- 30-31
2. Warning Signs Implementation ---------- 31-32
3. Facts Up Front Implementation ---------- 33-34

V. **Conclusion** ---------- **34-35**

VI. **Bibliography** ---------- **36-43**

VII. **Appendix: Abbreviation List** ---------- **44-45**

Introduction

A suboptimal diet, consisting of both excesses of unhealthful foods and deficits of healthful foods, is a principal exacerbator of poor health and chronic disease.[1,2] The Global Burden of Disease study has consistently shown over the years that a high intake of sodium, and a low intake of whole grains, fruits, and vegetables were the leading dietary risk factors for deaths and disability-adjusted life years. [3–5] The current food retail environments worldwide offer a plethora of ultra-processed foods that contribute to suboptimal diets.[6] Effective public and private policies that enable consumers to make healthier dietary decisions are paramount to mitigating the global nutrition burden.

General food labeling is an age-old policy in public health, with nutrient declarations, usually in the form of back-of-package labels (BOPLs), displaying information on the foods' macronutrient and micronutrient composition and ingredients.[7] While nutrition policies vary based on country context, most nations abide by the labeling provisions of the Codex Alimentarius Commission (CAC), an international authority for food standard setting established by the World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO).[8] From a consumer standpoint, however, BOPLs can be numerically dense, raising accessibility concerns for populations with lower education levels.[9] These labels can also be underutilized, resulting in unaffected consumer choice.[10] Intended to increase the consumer's understanding of the food product's nutritional content, the Codex also outlines guidelines for supplementary nutrition information in a 2021 annex on front-of-package nutrition labels (FOPLs). [11]

As of May 2022, forty-four countries have introduced FOPL in some capacity.[6] FOPL systems use aids like symbols, colors, numbers, or letter grades to equip customers with

supplementary nutritional knowledge to make informed choices. [9,12] Labeling schemes can vary in design. Interpretive FOPL systems provide an at-a-glance display of the relative healthfulness or unhealthfulness of a product, whereas non-interpretive systems provide numerical nutrient composition information with no advice on the overall nutritional value of food. Some countries mandate FOP labels, whereas other countries only have a voluntary system. [6]

The Nutri-Score, created by France, and adopted by seven other European countries, is a voluntary system that provides a summary indicator of the healthfulness of the food product. Variations of the Warning Signs label are adopted by Chile, Mexico, Brazil, and Canada, which is a mandatory system that provides indicators of high levels of nutrients that can increase the risk of diet-related NCDs. [6,13] Other countries do not have an interpretive system in place. The United States falls into this category, with the U.S. food industry proposing the implementation of Facts Up Front as a voluntary labeling system that displays information on calories, macronutrients, and some micronutrients. This information is a "fast facts" version of the mandatory back-of-package label [14,15] (Figure 1).

Fig. 1: General Formats of the Nutri-Score, Warning Signs, and Facts Up Front Labels

Nutri-Score[16] (left); Warning Signs[17] (top right); Facts Up Front [18] (bottom right)

A vast body of research suggests that FOPLs have merit and can encourage consumers to make healthier choices; however, there is still not a unanimous consensus on which systems are most effective in improving the nutritional quality of a population. There is also less literature on what factors and stakeholders affect the implementation of specific FOPL systems in varying regions and countries. This paper will analyze the theoretical and practical effectiveness of three FOPL systems: the Nutri-Score in select European countries, the Warning Signs system in select Latin American countries and Canada, and the Facts Up Front system in the United States. Each system will be measured according to the WHO and CAC international guidelines on FOPL labels. Additionally, the perspectives of relevant stakeholders will be analyzed to understand how each system works in practice.

RQ: How do three FOPL systems, the Nutri-Score, Warning Signs, and Facts Up Front, differ in theoretical and practical effectiveness?

Methodology

The research method is a comparative analysis of the effectiveness of three FOPL systems. Theoretical effectiveness is defined by the system's alignment with established international guidelines. Practical effectiveness is more subjective; it is measured by the viewpoints of various stakeholders, including governments, food manufacturers, and academic researchers. It is important to note that no consumers were directly interviewed or studied in this paper; rather, all consumer data is derived from secondary literature.

The methodological design is composed of primary and secondary data. Primary data consists of interviews with experts from France, Switzerland, and the United States. Interviewee selection criteria included any individuals or organizations with professional experience in (1) one or multiple front-of-package nutrition labeling systems (2) consumer choice or (3) food

systems. This criterion was constructed to include expert opinions for each of the FOPL systems, understand drivers of consumer choice, build general knowledge of FOPL systems, and involve a broader lens of food systems to offer insightful, innovative policy recommendations to improve nutrition indicators in the population. As the paper is a global comparative analysis, there were no geographical boundaries when seeking interviews. Any interviewees who resided outside of Switzerland were offered a virtual option. If interviewees lived in Switzerland, there was a preference for in-person interviews; however, due to schedule conflicts, all interviews conducted were virtual.

In total, this paper included six interviews with professors, a dietician, and a journalist (1) Dr. Chantal Julia, a professor at Sorbonne Paris Nord University and one of the developers of the Nutri-Score labeling system; (2) Dr. Tassos Kyriakides, professor at Yale University, (3) Dr. Marlene Schwartz, professor at University of Connecticut; (4) Dr. Jim Thrasher, professor at the University of South Carolina; (5) Dr. Sandrine Lasserre, Geneva-based dietician; (6) Laurent Gaberell, agriculture and food journalist at Public Eye CH.

Secondary data included peer-reviewed academic literature and books with policy briefs, and research reports, found using the research databases Google Scholar, JSTOR, and the Lancet. Other gray literature, including publications from international and governmental organizations such as the WHO, FAO, OECD, PAHO, and USDA, legislative texts, and relevant news articles. Search criteria were based on several topics: (1) General Front-of-Package Nutrition Labels and Policy (2) Drivers of Consumer Food Choice (2) Mandatory FOPL (3) Voluntary FOPL (4) Nutri-Score FOPL (5) Warning Signs FOPL (6) Facts Up Front FOPL. The final set of literature was only included in the literature review and analysis if it offered relevant information to this search criteria.

In terms of ethical considerations, all interviewees provided informed consent after being given the aim of the study and the nature of their participation. All interviewees consented to be recorded for transcription purposes. No interviewees asked to remain anonymous. Limitations of this methodology could include potential sampling bias, as interviewees were located through a review of peer-reviewed and gray literature on current FOPL and food systems, along with connections via academic advisors from the School of International Training and the University of South Carolina. Furthermore, due to time and budget constraints, this paper relied on interviews with experts and secondary data to acquire information on drivers of consumer food choices within each FOPL system. This may have limited the scope and depth of the study, as no consumers were interviewed directly.

Literature Review

This section is a review of the current literature to understand the history, key components, praises, and criticisms of each FOPL system.

Nutri-Score

The Nutri-Score is a five-color, five-class front-of-package label that displays foods as healthy or unhealthy over a gradient. [19,20] The nutritional quality of products is ranked A to E, green to red, both across and within food groups.[20] The national public agency, Santé publique France, created the label based on the work of Dr. Serge Hercberg and his research team, the Nutritional Epidemiology Research Team (EREN).[16] The general algorithm places guideline- recommended foods, like fruits, vegetables, unsalted nuts, and whole grain products into healthier, A/B categories, and places non-recommended foods, such as processed meats and high-sugar or high-salt snacks into the D/E categories.[19]

The system was first implemented in France in 2017; Belgium and Spain followed suit in 2018, Switzerland and Germany in 2019, Luxembourg in 2020, and the Netherlands and Portugal in 2024.[21–24] In line with European Union (EU) regulations, front-of-package labeling as a practice is voluntary, including the Nutri-Score. However, if manufacturers do display the Nutri-Score, they must label it for all foods under their brand.

The initial Nutri-Score algorithm was derived from the United Kingdom Food Standards Agency nutrient profiling (NP) system, known as the FSA score. In general, guideline-recommended foods, like fruits, vegetables, unsalted nuts, and whole grain products, will end up in healthier, A/B categories, and non-recommended foods, such as processed meats and high-sugar or high-salt snacks will be in the D/E categories. [19]

There are several articles supporting the use of the Nutri-Score, many of which have members of EREN as contributors. A synthesis paper published in the Central European Journal of Public Health outlined primary results and conclusions from several different studies on the effectiveness of the Nutri-Score.[25] The paper overviews several studies that support that the Nutri-Score can positively influence consumer purchasing habits of healthy foods.[26–28] Another paper found that the Nutri-Score most improved consumers' abilities to determine the relative nutritional quality of products, compared to other FOPL systems.[29]

A critique of the system is that the Nutri-Score can mislead consumers about the nutritional value of foods. Examples of this critique are olive oil and soda. Initially, olive oil was labeled a C; the algorithm has gone through developments, now rating olive oil as a B.[19] Dr. Hercberg of EREN states that olive oil can never earn a green A on the algorithm because it is fat. Countering, Dr. Tasso Kyriakides and Dr. Vasilis Vasilliou from the Yale Olive Sciences and Health Institute argue that the Nutri-Score discredits the well-documented health benefits of

olive oil.[30] Dr. Kyriakides states, "If consumers who do not know about olive oil are exposed to the Nutri-Score labels, they can think that a soda drink would be healthier than olive oils." Other entities, including the Swiss Commission for Science, Education, and Culture, Swiss and Italian farmers, and the Italian government further comment on the system's inability to consider additives, country of origin, and sustainability.[31,32]

Warning Sign Labels

Warning Sign labels are present if a food is high in sugars, sodium, saturated fats, trans-fats, and/or calories. The label is demonstrated by black octagons with white-lettered messages. It was one of the four mandates implemented in Chile through the Food Labelling and Marketing Law in 2016, along with age restrictions on unhealthy product advertising, prohibitions on products sold in school, and requirements for nutritional education in schools.[33]

Numerous other Latin American countries and Canada have followed in Chile's footsteps.[34,35] Mexico was one country that changed a previously implemented FOPL to this system. In 2011, the Mexican Council of Consumer Industry, an organization consisting of the main manufacturers of ultra-processed foods in the nation, introduced the GDA system which the Mexican government mandated despite the dissent of public health leaders; Mexico replaced the system with the interpretive Warning Signs FOPL in 2020. Research supports that Warning Sign labels have high levels of consumer awareness, use, and understanding relative to other systems, even among low- and middle-income populations.[34–37]An important facet of the warning label system is that it is government-mandated to be displayed on all packaged products. Voluntary FOPL policies give companies the choice of affixing the label to their product, even if the system is government-endorsed. The Pan American Health Organization (PAHO) asserts that voluntary labels allow companies to selectively avoid labeling unhealthy products, or avoid the system

completely.[38] Variance in consumer understanding of Warning Signs compared to the U.K. Multiple Traffic Lights Label (MTL) or the Australian Health Star Ratings (HSR) FOPL could derive from differences in mandated versus voluntary policies.[39] A report shows that Australian manufacturers displayed the FOPL on less than 50% of pre-packaged foods. Overall, the labels were also on fewer products with lower nutritional quality. [40]

The industry has notoriously opposed the spread of the warning labels system. The 10 largest global food and drink manufacturers all operate in Mexico, and their total combined revenue was over 1 billion USD per day in 2012.[34] Food manufacturers like Nestle lobbied against mandatory systems because it would cost them billions in profit. [41]

Facts Up Front

In 2010, the Food and Drug Administration started a front-of-package labeling initiative. As a part of this, the Institute of Medicine (IOM) published two reports on the topic. The first report recommended that FOP labeling should provide information on critical nutrients that are related to diet-related health conditions; the second report focused on consumer understanding and behavior related to the development of a standardized FOPL. The second report concluded that the U.S. should move towards a labeling system that "encourages healthier choices through simplicity, visual clarity, and the ability to convey meaning without written information." However, before the release of the second report, U.S. food manufacturers put forth the non-interpretive labeling scheme called Facts Up Front.[15,42,43] Facts Up Front labels display numerical information about calories, saturated fats, sodium, and two (out of eight possible) nutrients to encourage that are in the product.[15,44] Facts Up Front is comparable to the old U.K. Guideline Daily Amounts (GDA) system, which also displays basic icons containing nutritional information with percentage calculation of one's recommended dietary intake.[45]

The industry is in support of the label, claiming that there is research in support of Facts Up Front's impact on consumer awareness. [46] However, Christina Roberto, a food policy expert at the University of Pennsylvania, believes that the food industry is standing in the way of more sensible, science-based labels that the U.S. Food and Drug Administration (FDA) should pursue. She asserts that for more than 10 years, Facts Up Front was a mechanism that helped the industry delay stricter regulation on the highly processed, nutrient-poor foods that the industry profits massively from [47] The Center for Science in the Public Interest (CSPI) claims that Facts Up Front-style labels do not affect consumer behavior, contrary to the industry's findings, and cited studies in favor of interpretive, mandatory, and nutrient-specific FOPL systems. [12,48,49]

Analysis

This section aims to thoroughly understand the factors that determine the effectiveness of food labeling systems in encouraging the consumption of healthy foods. First, it will overview which elements of front-of-package systems are recommended by international and national policy frameworks and guidelines. Then, these guidelines will be used to compare the effectiveness of the Nutri-Score, Warning Signs, and Facts Up Front labels, drawing from existing literature on stakeholder perspectives and primary interviews with experts.

International Guidelines and Policy Frameworks

The Codex Alimentarius Commission was established by the FAO and WHO in 1963 as the developmental entity for international food standards, guidelines, and codes of practices to protect consumer health and ensure fair practices in food trade. The CAC has provided guidelines on front-of-package labeling, intended to aid countries in developing FOPL that aligns with their national dietary guidance or nutrition policy. Codex guidelines mesh with the WHO Guiding Principles and Framework Manual for FOPL, which outlines procedures for developing,

implementing, monitoring, and evaluating labels. The manual contains principles for the content and format of the label. The 2019 WHO manual and 2021 Codex Annex provide overarching principles for label development, including that it is unified, well-monitored, transparent, accessible, and in line with national policy. The system should be government-led but in consultation with the private sector, consumers, academia, public health associations, and other stakeholders. Furthermore, the guidelines offer principles for FOPL system design, content, and implementation (Table 1).[6,11,50]

Table 1: Principles of Development, Design, Content, & Implementation for FOPL[6,11,50]

Development and Design	Content	Implementation
Developed by the government, but in consultation with the private sector, consumers, academia, public health associations, and other stakeholders	Encompass nutritional criteria that aim to inform choice and promote healthy diets	Use regulatory or voluntary approaches to encourage uptake of the system
Interpretive, based on symbols, colors, words, and/or quantifiable elements	Enable appropriate comparisons between food categories, within a food category, and between foods within a specific food type	Engage with industry groups early, and develop guidance documents (i.e., style guide)
Supported by consumer testing, evidence of system performance, and stakeholder engagement		Engage with key opinion leaders (including food and nutrition experts and the media) and consumers
Understandable to all population subgroups		Resource public education campaigns with a focus on at-risk groups
		Collect baseline data to evaluate the impact of labels on consumers and the reformulation of food products

These principles were developed to support countries in the development, implementation, monitoring, and evaluation of a contextually appropriate FOPL system to bolster healthy food systems; thereby, they offer standards of effectiveness to compare existing FOPL systems against.

Principles of Development

1. *"The FOPL system should be government-led but developed in consultation with all interested parties including the private sector, consumers, academia, public health associations among others"* [11]

Nutri-Score Development

The Nutri-Score was a government-led, academia-supported initiative at the time of its development in France. Aforementioned, the Nutri-Score was introduced as a voluntary regulatory measure by the national public health agency, Santé publique France, and the French Ministry of Health (MoH).[16] The MoH tasked Dr. Serge Hercberg, professor and the head of the National Nutrition Health Program in France at the time, with a report on the various areas that public policy and nutrition that could be improved. The report was created in consultation with various experts in the field and proposed several measures, including the use of a Nutrient Profiling (NP) model for three purposes: front-of-pack labeling, taxation, and regulation of advertising. Research on the validation of the NP model and necessary modifications was developed by the academic work of Dr. Serge Hercberg and his research team, EREN. [51] The French High Council for Public Health was also involved in the development of the label and was tasked with determining final algorithmic modifications of the NP model and the Nutri- Score. As various countries adopted the system, the system further developed with the creation of the International Scientific Committee of the

Nutri-Score in 2021, which includes relevant authorities from France, Belgium, Spain, Switzerland, Germany, Luxembourg, and the Netherlands to assess possible evolutions of the system for better consumer health.[16]

Key food manufacturers, Coca-Cola, Mars, Mondelez, Nestle, PepsiCo, and Unilever, opposed the Nutri-Score and other labeling systems and proposed an alternative label called the "Evolved Nutrition Label," or ENL, a modification of the MTL label. [52] Whereas the nutritional composition calculations for the Nutri-Score and Traffic Lights system are based on the nutritional composition of 100g of product, the ENL was based on "small" portion sizes, or less than 60g. The portion change of the ENL could be misleading to consumers, as food products would be scaled up a grade on the ENL instead of appearing as an "E" or red like on the other two FOPLs. [53] However, the manufacturers suspended the ENL about a year later, in late 2018, after receiving public criticism. [54] And, in 2020, Nestle – as a member of a coalition of consumer organizations, academics, European parliamentarians, and other companies in the food industry – released a statement regarding the company's support for the Nutri-Score to become the mandatory FOPL system of the EU. [55]

Warning Signs Development

In 2014, member states of the Directing Council of PAHO mandated PAHO to develop a Nutrient Profile (NP) model because the Americas had the highest obesity epidemic in the world. PAHO created an expert consultation group, consisting of nutrition authorities from academia, government, and health organizations to create the NP model. The model develops regional criteria for acceptable amounts of critical nutrients (salt, sugar, saturated fats, and trans fats) in order to implement public nutrition policies – such as a Warning Sign FOPL – that prevent the consumption of unhealthy foods. The Chilean government, which

had already initiated a Warning Sign FOPL in 2012, agreed to use the NP model to guide implementation efforts. Other countries in the region agreed to the same and mandated the label for food manufacturers. [56]

Transnational food manufacturers and even some foreign governmental agencies were not in support of the label's development. [37,41] In a Public Eye article co-written by food journalist, Laurent Gaberell, the responses of multinational companies like Nestle when Latin American governments implemented the warning labeling system are outlined. Nestle, headquartered in Switzerland, sought the support of the Swiss State Secretariat for Economic Affairs (SECO) to prevent the mandate. SECO and Nestle expressed concerns about the system to the Mexican government and instead recommended the use of the voluntary Nutri-Score. Furthermore, Switzerland, the EU, the U.S., Costa Rica, and other countries submitted a "Specific Trade Concern" regarding the mandatory labels to the Technical Barriers to Trade (TBT) Committee of the World Trade Organization (WTO). The countries voiced concerns about Codex regulations and food supply issues due to the COVID-19 pandemic, and requested amendments and postponements; however, the Mexican mandatory FOPL still went into effect later that year. [41,57]

Prior to intervening in Mexico, Nestle and SECO attempted to stop the Chilean government from mandating warning labels on Nestle's products in 2013 and raised concerns about Peru and Ecuador's potential implementation of similar FOPL systems. SECO questioned whether labels that sent negative messages and set nutrient thresholds were aligned with the Codex. At the time, the Codex did not contain the guidelines on FOPL systems that exist in present-day Annex 2. PAHO affirmed that the Codex did not prevent countries from creating their own labeling schemes and that countries could go beyond

Codex guidance. [38] In an interview with Laurent Gaberell, he furthered, “Codex is the minimum common denominator, but it is being used as a maximum for what countries are allowed to do.” Gaberell summarizes his work by pointing out that Mexico has one of the highest rates of obesity in the world and the government finally took action, yet the food industry and trade organizations will always be against stricter labeling due to profit losses. [58]

Facts Up Front Development

In an open letter, then commissioner of the FDA, Dr. Margaret Hamburg expressed the importance of nutrition labeling to the food industry. [44,59] This letter, paired with an IOM report emphasizing the importance of an effective FOPL system, led to the development of Facts Up Front.[15,42] Facts Up Front is an industry initiative, and it did not concur with final recommendations from the IOM regarding the development of an interpretive system instead of one that relied on the conveyance of numerical information. [15,42,43] Furthermore, when the FDA was asked if they would propose an alternative uniform scheme or if they would just monitor the voluntary approaches of the industry, a spokesperson affirmed the latter. [60]

Grocery Manufacturers Association (GMA) and Food Marketing Association (FMI), national trade associations for the U.S. food industry, asserted that the FOPL system was advised by a panel of third-party experts with varying health, nutrition, and medical backgrounds, but there was also dissent from experts. In 2014, Dr. Marion Nestle, professor of nutrition, food studies, and public health at New York University, wrote, "The IOM recommended that front-of-package labels be: Simple: easy to understand; Interpretive: putting judgments in context; Scaled: indicating good, better, and best. Facts Up Front does none of the above. Facts Up Front is a tool for selling, not buying.” [61] CSPI Executive Director, Michael Jacobson, stated, “CSPI petitioned the FDA to design and implement a

front-of-package labeling system back in 2006." He furthers that Facts Up Front was an industry mechanism to preempt an FDA-designed system that is science-based, easily understood by all, and mandatory. [29]

Principles of Design

1. *"The FOPL system should be interpretive, based on symbols, colours, words and/or quantifiable elements."* [50]
2. *"The format of the FOPL system should be supported by scientifically valid consumer research."* [11]
3. *"The design of FOPL systems should be understandable to all population subgroups."* [50]

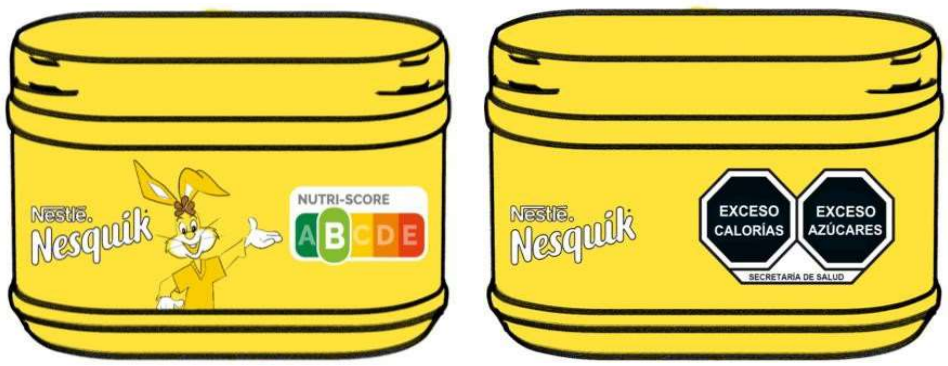
Nutri-Score Design

The Nutri-Score relies on colors and a grading scale to convey nutritional information, making it interpretive. According to Dr. Chantal Julia, one of the researchers on EREN attributable for the development of the Nutri-Score, the design of the label allows for a "comprehensive translation of the actual composition of the back-of-the-pack label for consumers," as the algorithm of the Nutri-Score is calculated only through the summation of nutritional content available on the BOPL. [51]

Dr. Tassos Kyriakides, a strong proponent of the Mediterranean diet, argues that the label could be deceptive to consumers by not accounting for the synergistic effects of foods and their downstream impact on health. He uses olive oil's 'B,' formerly 'C,' rating as an example: "Any FOPL has to incorporate the synergistic effects of foods and their downstream impact on health. Olive oil, for example, I am not going to consume it by itself usually. There is a lot of evidence that shows if you cook your vegetables in olive oil, it allows for the absorption of the phytonutrients in the vegetables much better. [30,62]

However, there is a – negative – instance of the industry accounting for food synergy in their product's Nutri-Score. When comparing Nestle's support for the Nutri-Score versus the Warning Signs label, Laurent Gaberell studied the product, Nesquik. The Nesquik ingredient list contains 75% sugar, 23% cocoa powder, and small amounts of salt, soy lecithin, vitamins, flavoring, and cinnamon. However, the powder receives a light green "B" on the Nutri-Score because the rating is based on a recipe defined by Nestle that accounts for the preparation of Nesquik milk (powder + milk). The BOPL provides information per serving of 1 scoop of Nesquik with 200 mL of the nutritionally favorable semi-skimmed milk (Figure 2).[41,58] Thereby, the fact that the milk and powder are rated in tandem results in a higher rating, per the format of the Nutri-Score. Fortunately, this loophole was closed by the modified Nutri-Score algorithm, which now primarily classifies sweetened milk beverages, like Nesquik and milk, as a D or an E. [63]

Figure 2: Nesquik: Nutri-Score and Warning Signs Rating [41]



The Nutri-Score is generally supported by scientifically valid consumer research. The French Fund for Food and Health (FFAS) conducted a study on the impact of FOPLs on actual buying conditions. The FFAS tested 4 systems over 10 weeks of study under actual conditions in 60 shops in France, with 50% of shops situated in areas with high populations of

low-income individuals. The study found that the Nutri-Score and two other European FOPLs had an unambiguous positive ability to bring modifications in consumers' buying habits, with a fairly clear superiority for the Nutri-Score.[28] Additionally, in a laboratory-framed field experiment with real purchases, the impact of five FOPL systems on the nutritional quality and cost of a daily consumption basket was studied. All labels except for Reference Intake (RI) improved nutritional quality, but the Nutri-Score was significantly more effective. Furthermore, an international experimental study asked 12,000 consumers from 12 different countries to compare foods within a specific food category (i.e., pizza), labeled with one of five different FOPL systems, including Warning Signs. It found that all FOPL systems improved participants' abilities to sort products according to relative nutritional quality correctly, and the Nutri-Score performed the best across the board. [29]

Warning Signs Design

The Warning Signs label relies on color, symbols, and quantifiable elements to convey critical nutrients to avoid, making it interpretive. The amount of black warning signs on each product can be counted to determine how many critical nutrients the product is high in. Dr. Thrasher, a professor at the University of South Carolina with expertise in tobacco- and nutrition-related policies and behaviors, asserts that Warning Sign labels are a simplified system, especially because consumers can just count the number of stop signs on the front of the package to determine how many critical nutrients are in the food. [64] Involved in numerous FOPL studies, Dr. Thrasher discussed a paper that he contributed to, which sourced data from the 2017 International Food Policy Study. This study found that participants had a greater understanding of the Warning Sign label than other FOPL systems, consistent across ethnic subgroups. Furthermore, participants used the GDA FOPL less often than BOPLs. [64,65]

A comparative study of HSR, MTL, GDA, and Warning Signs FOPL systems and the nutrition facts BOPL further supports that the design of Warning Signs is understandable. The paper used data from the 2018-2020 International Food Policy Study and found that in 2020, awareness, use, and self-reported understanding of the Warning Signs was the highest among all countries with a FOPL. At the time of the study, the Warning Signs FOPL had been implemented in Mexico for less than a year; for six years prior, the GDA FOPL was mandated. Yet, 79% of participants understood the warning system, compared to only 52% of participants understanding the GDA system, even though the latter had relatively high investments for promotion. [66] Another study, with low- and middle-socioeconomic status adolescents, young adults, mothers, fathers, and older adults who resided in Mexico City, also supported the conclusion that Warning Signs were more effective than the GDA system; it also found that red warning labels had a better subjective understanding than black ones. [37]

An unexpected effect of the Warning Signs implementation in Mexico was the spillover effect into the United States. In his interview, Dr. Thrasher referenced his research on the topic. The 2021 International Food Policy Study surveyed Mexican Americans in the U.S. on their purchasing habits at Mexican-oriented grocery stores. The study found that of the 88% of participants who purchased foods in Mexican stores, 64.1% noticed the Warning Signs FOPL. 32% and 44% of these participants also reported that the FOPL influenced them to buy fewer chips and colas, respectively. Interventions that target lower groups with lower socioeconomic status and health literacy should consider this positive spillover effect. [64,67]

Facts Up Front Design

The Facts Up Front label is non-interpretive; it does not utilize a range of colors, symbols, or scales to convey nutritional information. Though the label is inherently numerical, and thus

"quantifiable," there is no specific advice or judgment passed on the healthfulness of a product, which is a key element of an interpretive label. [6]

The industry provides consumer research to support its design. GMA stated that according to an online survey by Harris Poll on behalf of GMA, 93% of consumers agreed that Facts Up Front makes nutrition information easy to find and use. FMI President and CEO at the time, Leslie G. Sarasin furthered: "Our research tells us that more than two-thirds of shoppers read food labels, looking for information related to sodium content, sugar, fat and calories." [46] However, much research and consensus is in opposition to the FOPL. Released right after the development of Facts Up Front, the second IOM report concluded that the most successful FOPLs are (1) simple and do not require specific nutritional knowledge (2) interpretive with the provision of guidance, rather than specific facts; (4) ordinal, with guidance offered as a scaled or ranked approach; (4) supported by easily remembered names or identifiable symbols. [43] Though it can be argued that Facts Up Front is an easily remembered name, other attributes are lacking.

Dr. Marlene Schwartz, Director of the Rudd Center for Food Policy & Obesity at the University of Connecticut, believes that the United States should adopt a more interpretive label, one that plainly shows the healthfulness of a product. " I don't think it's particularly helpful to have [the label] be just information that's on the back, but instead on the front," she states, "The idea that people can use percentages in a meaningful way is just asking for a lot." [68] Dr. Thrasher concurs, "Nutrition facts labels on the back or the side of food packaging, are incredibly complicated for people to understand, especially for. people … [who] have lower levels of education and lower levels of health literacy." [64]

Supporting the effectiveness of the FOPL, one study focuses exclusively on the impact of Facts Up Front within different racial groups in the United States rather than a comparative analysis of multiple FOPLs and found that mothers who are primary household shoppers engage with and understand Facts Up Front; particularly, African American and Hispanic mothers, who are disproportionately affected by diet-related diseases in the U.S., are more engaged. [69] However, this study was not comparative of other FOPL systems, and research supports the fact that the presence of any label can be better than no label at all. [12,15] Additionally, though not directly studying Facts Up Front, there is vast literature on the ineffectiveness of the similar GDA system in comparison to other FOPL labels such as the Warning Signs, aforementioned in the previous section.

Principles of Content

1. *"Content should encompass nutritional criteria… that aim to inform choice and enable interpretation of food products [that support] against risks for diet-related noncommunicable diseases (NCDs) and … [promote] healthy diets."* [50]
2. *"The FOPL system should enable appropriate comparisons between food categories, within a food category, and between foods within a specific food type*." [50]

Nutri-Score Content

Though the label does not explicitly state positive nutrients to include in one's diet, or negative nutrients to avoid, Dr. Julia affirms that on average, the Nutri-Score maintains the global hierarchy among foods because the algorithm was developed by the International Scientific Committee of the Nutri-Score according to food-based dietary guidelines. The system assigns positive points for "unfavorable" nutritional content (+10 per category): calories, total sugar,

saturated fatty acids, and sodium. Negative points are assigned for "favorable" content (-5 per category): proteins, fruits, vegetables, nuts, and certain oils. Both totals are summated, yielding a global score of -15 for the most healthy foods, and +40 for the least healthy foods. Thus, each food is classified as a grade/color on the label depending on its score range. [19] The label also allows for comparisons within food categories; Dr. Julia provides the example of breakfast cereals, in which the complete A-E rating scale is represented because the amount of sugar, whole grains, and saturated fats varies drastically. [51]

The algorithm has gone through one revision in 2022-2023. This revision gives more weight to artificial sweeteners in beverages, corresponding to a shift to one unhealthier category, and it penalizes high-salt and high-sugar products more greatly. It also attributes less weight to oils with lower saturated fats, shifting some oils to a healthier rating. [16,51]

Critiques of the system include that the algorithm does not adequately promote healthy diets, despite revisions. Dr. Kyriakides presents the example of Coke Zero, which does not have sugar, saturated fatty acids, or sodium, so it scores well compared to olive oil and honey, which are both high in calories. In a position paper, he writes, "No matter how one tries to explain and justify the categorization of Coke Zero with [the same]... Nutri-Score … [as] extra virgin olive oil … it is in clear contradiction to the accumulated science supporting and proving the health benefits of the natural juice from olives." [30] Dr. Lasserre, a Swiss dietician, further adds that the Nutri-Score could benefit from the inclusion of vitamins and minerals, natural versus added sugars, amount of processing, and quality and sustainability of production.[70] And, in 2023, the Swiss Council of States approved a motion of the Commission for Science, Education, and Culture to consider potential flaws of the already-adopted Nutri-Score, including that it does not discriminate between processed and ultra-processed foods. [31]

Dr. Julia asserts that the Nutri-Score cannot account for processing due to regulatory and scientific reasons. Firstly, though there is research on how processing negatively affects health independently of nutritional composition, there is not enough scientific knowledge on the weight of processing compared to the weight of the composition. Secondly, there is no regulatory document from the European Commission that determines which elements would classify a product as processed or ultra-processed (like the Nova classification).[51,71] For the same reason, Nutri-Score also cannot account for added sugars. Dr. Julia agrees that factoring in added sugars versus natural sugars would improve the accuracy of the label. However, EU regulations do not allow a FOPL to include any nutritional elements not present on the BOPL, and manufacturers are not required to distinguish between added versus natural sugars. [51]

Some national governments, like Italy, the Czech Republic, Greece, criticize how certain national food products, like cheese and olive oil, are rated harshly on the Nutri-Score. [72] In line with the opinions of Italian farming associations and food producers, the Italian Ministry of Agricultural, Food, and Forestry Policies argued that the Nutri-Score would penalize products from the Mediterranean diet and traditional Italian products. Italy has since proposed its own FOPL, the NutriInform Battery, and prohibited the use of the Nutri-Score on products that have a Protected Designation of Origin (PDO) or Protected Geographical Indication (PGI) certification from the European Union. [73,74]

The European Dairy Association also claims that the Nutri-Score negatively impacts consumer perception of the healthfulness of dairy products and does not account for the inability to reformulate products. [75] “Just because you can’t reformulate doesn’t mean you should deny consumers the reality of the product’s composition,” asserts Dr. Julia, arguing that exempting PDO and PGI products from Nutri-Score ratings is scientifically unsound.

Warning Signs Content

The PAHO NP Model provides classification criteria for food and drink products containing an excessive amount of sodium, free sugars, sweeteners, total fats, saturated fats, and trans fats (Table 2). These criteria are illustrated by the Warning Signs FOPL. The NP Model does not need to be applied to unprocessed/minimally processed foods, such as fruits and vegetables, meat, fish, milk, and eggs.

The PAHO Expert Consultation Group asserts that most, if not all, national FBDGs recommend regular consumption of these foods. Furthermore, the NP model was not developed for the classification of culinary ingredients, such as "salt, plant oils, butter, lard, sugar, honey, and other single substances directly extracted from foods or nature." The NP Model does not deem it appropriate to assess these ingredients' individual nutrient profiles because they are usually used "to season and cook unprocessed or minimally processed foods." The PAHO NP Model's exceptions of certain products is an important consideration, given that a qualm of the Nutri-Score was the potential mislabeling of products like olive oil and cheeses. However, this consideration should also encompass the lack of differentiation between the health benefits of certain cooking ingredients over others, although PAHO does state that countries concerned about high intakes of minimally processed foods and culinary ingredients could address this in their national FBDGs. [56]

Table 2: **PAHO NP Model Criteria for Identifying Processed/Ultra-Processed Products Excessive in Critical Nutrients** [56]

Sodium	Free sugars	Other sweeteners	Total Fat	Saturated Fat	Trans Fat
≥ 1 mg of sodium per 1 kcal	≥ 10% of total energy from free sugars	Any amount of other sweeteners	≥ 30% of total energy from total fat	≥ 10% of total energy from sat. fat	≥ 1% of total energy from trans fat

Multinational companies like Nestle are aforementioned critics of the label's nutrient profiling. In a summary statement, Nestle informed PublicEye that they are "committed to supporting people in achieving a balanced diet." but the Warning Signs FOPL "does not help to choose healthier options in a particular product category." [41] However, PAHO also stands firm in the belief that the FOPL system has a clear focus to help consumers identify the food products that contain an excessive amount of one or more critical nutrients: "merging or adding information about positive nutrients or attributes into the FOPL system would divert its purpose, dilute the effect, and increase consumer confusion." PAHO adds that products carrying the Warning Signs FOPL are typically ultra-processed; these products not only have excessive amounts of crucial nutrients but likely also contain lower amounts of positive nutrients. [38]

Dr. Thrasher states, "Relative to comparing all the complicated information on the Nutrition Facts label, it is a lot easier and quicker for people to make comparative decisions at the point of sale with the interpretive warning label system." [64] Consumer research supports the effectiveness of the FOPL content in promoting healthy diets. One study used longitudinal data on food and beverage purchases from 2381 Chilean households from 2015- 2017 to examine the changes in calorie, sugar, saturated fat, and sodium content after the implementation of the Warning Signs FOPL. Findings displayed that all nutritional categories decreased in purchase.[36] These findings were consistent with other studies on Warning Signs FOPL systems in Chile and Canada. [35,76,77]

Facts Up Front Content

If manufacturers choose to implement Facts Up Front, they are required to display calories, saturated fat, sodium, and sugars per serving. Percentage daily values (% DVs) are

also included, based on the recommended daily intake for a 2000-calorie diet. If products have less space on their packaging, they have the option to display just one fact. Companies can also choose to include "nutrients to encourage," which are protein, dietary fiber, calcium, iron, potassium, vitamin A, vitamin C, and vitamin D. [15,18] Dr. Schwartz argues that this type of format does not allow for easy comparison among and within food groups. The labels do not have a broad schematic for comparisons like the Nutri- Score or Warning Signs; rather, the nutrient information is specific to each product. She uses frozen pizza as an example: "Consumers cannot easily compare the nutrient facts on 42 frozen pizzas without opening the freezer. But, if that were labeled so that you could easily find the pizza with the best nutrient profile, it could make a huge difference." [68] Facts Up Front content may not enable accurate interpretation of healthy and unhealthy food products. A study that Dr. Schwartz contributed to compared the MTL FOPL to Facts Up Front. Consumers in the study who viewed products with the Facts Up Front Label (without "nutrients to encourage" labels) were more likely to underestimate sugars and saturated fats and overestimate fibers and proteins compared to MTL. Consumers also viewed Facts Up Front as having too much information on it, increasing the time it took to understand the label. The study concluded that the Facts Up Front label could be improved using a color-coded traffic light scheme, rather than % DV information to best educate consumers. [15]

Principles of Implementation

1. *"Uptake of the FOPL system should be encouraged across all eligible packaged foods, either through regulatory or voluntary approaches."* [50]
2. *Early engagement of industry groups and the development of guidance documents (i.e. style guide) are necessary for facilitating the implementation of the FOPL system"* [50]

3. *"Engagement with key opinion leaders (including food and nutrition experts and the media) and consumers is essential and should be well managed."* [50]
4. *"FOPL should be accompanied by a consumer education/ information program…"* [11] *with "special consideration of techniques to target at-risk groups are necessary for improving nutrition literacy, consumer understanding and use of the FOPL system"* [50]
5. *"FOPNL should be monitored and evaluated to determine effectiveness and impact"* [11] *on "consumers and reformulation of food products"* [50]

Nutri-Score Implementation

EU Regulation 11-69 prevents any label from being mandated in an EU member country; thereby, all FOPL schemes can only be voluntary. The Nutri-Score, adopted by eight countries, is one of six developed FOPL schemes present in the EU markets currently. In 2020, the European Commission, the EU's politically independent executive arm, proposed the introduction of a mandatory FOPL by the end of 2022 after conducting an impact assessment on the different FOPL systems in Europe.[78] However, this mandate has not occurred; Dr. Julia speculates that this postponement is due to intense lobbying from the dairy industry, processed meat industry, other food manufacturers, and national governments, aforementioned. [51]

The different preferences of European members are challenging perspectives to unite under an international governance-mandated FOPL system. [72] In its stead, Dr. Lasserre advises policymakers to mandate sugar reduction by modeling the Declaration of Milan, a commitment to reduce the burden of unhealthy excess weight in Europe. [70] The Declaration was announced by the European Association for the Study of Obesity along with the Italian Society of Obesity at the 2015 Milan Expo. The declaration invoked the Swiss governmental

strategy of reducing sugar in various product categories, such as yogurt, breakfast cereals, and sweetened beverages. By 2017, 14 Swiss food manufacturers signed the declaration. Since 2018, the added sugar content of yogurt has decreased by 5% and 13%, respectively, exhibiting product reformulation. Efforts continue to be monitored by the Swiss Federal Food Safety and Veterinary Office. [79,80]

Santé publique France provides information on the development, design, content, and algorithm calculators of the Nutri-Score for consumers, along with implementation guidance documents for food manufacturers on their website. Additionally, the website provides relevant reports and contact information of member states' representatives of the transnational steering committee. This committee serves to coordinate the implementation of the Nutri-Score and ease the use of the FOPL by food business operators. [16]

The Nutri-Score should be complemented with consumer education programs. Dr. Lasserre furthered this point in her interview, discussing her daily use of nutrition education with her clients as a dietician. She helps clients use the Nutri-Score to compare different food products, equipping them with knowledge about how to decipher both the FOPL and BOPL, along with information about processing and production not reflected by labels. She urges policymakers to complement FOPL schemes with nutrition education programs in schools. [70] Dr. Julia concurs, stating that the Nutri-Score alone is not enough to improve consumer knowledge of health. [51]

Warning Signs Implementation

The Warning Signs label is mandatory in implementation. PAHO puts forth: "The food industry is unlikely to comply with any voluntary FOPL that highlights negative properties of products they manufacture and discourages their purchase by consumers." PAHO remains

steadfast in the belief that public health measures that address important population risks (such as obesity) should be mandatory. [38] Additionally, other policies on marketing complement the FOPL; Chile and Mexico ban products from displaying cartoon characters, toys, or celebrities on the package if they bear a warning label. [41,81]

PAHO has created documents overviewing what the NP Model is, and how to use the FOPL as a policy tool. These guiding documents are educational tools for both consumers and manufacturers. As the FOPL is mandated by specific countries, additional guidance documents will be country-specific. For example, Mexico's Health and Sanitary Risks Authority published a manual to provide guidelines on required information and labeling formats for processed foods and beverages. The USDA Foreign Agricultural Service translated the manual to inform U.S. manufacturers interested in entering the Mexican market. [82]

When fighting the adoption of the Warning Signs FOPL in Mexico, Nestle argued that consumers were not sufficiently educated on nutrition, and that information campaigns should be prioritized instead of warning labels.[41] PAHO concurs that educational initiatives are important, but only as complements to policy changes, adding, "FOPL is an education tool in itself, as it provides information that helps educate consumers about the content of food products." [38] Additionally, Warning Signs can encourage product reformulation. A study found that after Chile implemented the Food Labeling and Advertising Law in 2016, the number of products that qualified for an excessive sugar label and excessive sodium label decreased from 80% to 60%, and 74% to 27%, respectively. There was not much change in the amount of products high in calories and saturated fat. Furthermore, the distribution of critical nutrients in most food groups moved just below nutrient cutoffs, so companies may be reformulating just enough to avoid the label. [83]

Facts Up Front Implementation

In 2012, FMI released a guidance document for manufacturers who chose to adopt voluntary implementation of the label. [84] Dr. Thrasher notes: " I don't think Facts Up Front provides much motivation [to producers] to reformulate products to make them healthier, as consumers are not responding by not buying products because the information is too complicated for them to understand and use." [64] To increase consumer understanding, The Facts Up Front label was paired with a $50 million national consumer education campaign in 2014. [15] There is not ample research on the effectiveness of the educational campaign, but FMI wrote that the campaign includes online toolkits for retailers and print, digital, and in-store communications that direct consumers to the Facts Up Front website, where consumers can learn more about nutrition. [46] However, the Facts Up Front website states that it is currently under construction. [85]

The FDA announced in 2023 that the agency was undertaking consumer research to propose a standardized FOPL system in the U.S., replacing the Facts Up Front initiative. [47] Dr. Schwartz pointed out that mandating a FOPL system will not be easy: "In the United States, because of the first amendment [free speech], it becomes very difficult to … regulate [the industry]." [68] Dr. Thrasher concurs, saying that other countries are implementing effective labeling systems because they have legal systems that allow for the government to adopt and implement more stringent policies. He draws upon an example from the tobacco industry. In 2009, Congress gave the FDA the regulatory authority to implement graphic pictorial warnings on cigarette packs by 2012. Over ten years later, these labels have not been mandated due to industry litigation of First Amendment rights. He compares, "the food industry pays a lot of attention to how the tobacco industry deals with these kinds of issues,

learns from it, and knows how to work the legal system in the same way. I am cynical of the [United States'] ability to first adopt, and then *implement* a policy like this." [64] The FDA intends to issue a proposed rule on the potential new FOPL system by June 2024. [47]

Conclusion

As diet-attributable NCDs increase in prevalence, front-of-package labels can be used as tools to improve the health of the population. FOPLs can influence consumer choices through increased nutritional awareness and additionally encourage the industry to reformulate their products to reduce the amount of unhealthy nutrients. The design, content, and implementation methods all play a role in determining the effectiveness of the policy, a fact supported by both policy frameworks and actual stakeholder perspectives.

This paper measured the theoretical effectiveness of the Nutri-Score, Warning Signs label, and Facts Up Front labels by applying the WHO and Codex guidelines, which are established and reputable international policy frameworks. The Warning Signs Labels met most criteria, such as being interpretive, developed by the government in consultation with other stakeholders, being understandable by all subgroups, and encompassing nutritional criteria. The Nutri-Score mostly met these criteria, but it was more divisive in consensus. The Facts Up Front label lacked in most of these imperative areas.

The practical effectiveness was analyzed by assessing various stakeholder perspectives of the three FOPLs. The analysis found that the industry primarily supports non-mandatory and/or non-interpretive labels. In the United States, industry intervention led to the development of Facts Up Front, and lobbying efforts have stalled the development of a more uniform, interpretive system. In the region of the Americas, the development of the mandatory warning label was met with resistance from transnational food companies, who would lose

billions of dollars in profit due to the FOPL and associated policies – such as removing cartoon marketing from products marked excessive in a critical nutrient. Nonetheless, numerous countries implemented the label. In Europe, however, the Nutri-Score has yet to be mandated by any country. Per European Commission regulations, any FOPL system can only be voluntarily implemented in an EU country. The EU has discussed the possibility of mandating a FOPL, with the Nutri-Score being a strong contender. However, the Nutri-Score has been met with opposition from food manufacturers, governmental authorities, and some academics who claim the system discriminates against established health benefits of certain non-reformulatable foods, such as olive oil and other traditional Mediterranean products, by rating them at equivalent or sometimes worse grades than some processed foods. Proponents argue that the Nutri-Score algorithm aligns with most countries' food-based dietary guidelines.

The WHO framework and Codex guidelines both concur that consumer research is essential to determine the effectiveness of any labeling system. Future research should evaluate how different FOPL systems can affect actual consumer purchasing habits, accounting for other important drivers of food choice, such as price, sustainability, and taste. Current research supports the idea that countries should seek to adopt interpretive FOPLs that provide nutritional guidance that consumers can understand easily and quickly. Other policy recommendations include the adoption of regulations that require the food industry to commit to both transparency and reduction of critical nutrients, whether this be through mandatory FOPL labels or alternative nutrition policies.

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Appendix: Abbreviation List

Abbreviation	Term
% DV	Percentage Daily Values
BOPL	Back-of-Package Label/Labeling
CAC	Codex Alimentarius Commission
CSPI	Center for Science in the Public Interest
ENL	Evolved Nutrition Label
EREN	Nutritional Epidemiology Research Team
EU	European Union
FAO	Food and Agriculture Organization
FDA	U.S. Food and Drug Administration
FFAS	French Fund for Food and Health
FMI	Food Marketing Association
FOPL	Front-of-Package Label/Labeling
FSA	United Kingdon Food Standards Agency
GDA	Guidelines Daily Amount
GMA	Grocery Manufacturers Association
HSR	Health Star Rating Label
TOM	Institute of Medicine
MoH	Ministry of Health
MTL	Multiple Traffic Lights Label
NP	Nutrient Profiling
OECD	Organization for Economic Co-operation and Development
PAHO	Pan American Health Organization
PDO	Protected Designation of Origin

PGI	Protected Geographical Indication
RI	Reference Intake Label
SECO	Swiss State Secretariat for Economic Affairs
TBT	Technical Barriers to Trade Committee
USDA	United States Department of Agriculture
WHO	World Health Organization
WTO	World Trade Organization