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Changes in the Competitive Environment and Their Evaluation in the Context of COVID-19: A Case Study

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Abstract: When evaluating the competitive environment in the context of the pandemic, the pandemic's global scale must be considered, since all products related to COVID-19 management have no regional competition but rather immediately switch to global competition and compete with similar products or substitutes. It should be noted that no products intended for managing the pandemic were available before its outburst. Even with the onset of the pandemic, not many specialized products, except for some general protection measures, were developed. However, in the two years after the pandemic began, competitive products intended for managing COVID-19 emerged into the market. The global scale of the pandemic automatically created worldwide demand for such products , which leads to a global shift in competitiveness. As a result, the competitive environment for products intended to manage COVID-19 is changing. Research purpose: To evaluate the competitive products—modern and robotized indoor disinfection equipment—available in the market and those under development. Research objectives: To develop a methodology for evaluating the competitive products and to select evaluation criteria and methods; to evaluate the competitive products in terms of their functionality and technical characteristics; and to research the channels and methods employed to launch competitive products into the market and provide analysis of best practice.

Keywords: COVID-19; competitive product; evaluation

Citation: Tu, Y.-X.; Gaidelys, V.; Čiutienė, R.; Žigienė, G.; Kovalov, B.; Jucevičienė, R. Changes in the Competitive Environment and Their Evaluation in the Context of COVID-19: A Case Study. *Sustainability* **2023**, *15*, 2664. https://doi.org/10.3390/su15032664

Received: 10 January 2023
Revised: 27 January 2023
Accepted: 30 January 2023
Published: 1 February 2023

1. Introduction

The COVID-19 pandemic, caused by the spread of the SARS-CoV-2 virus, has led to a global health crisis involving safety, social and economic issues [1]. One of the main factors leading to COVID-19 expansion is the number of asymptomatic patients [2]. In the area of dentistry, the pandemic has highlighted the risk of infectious diseases that can negatively affect the health of dentists, their assistants and patients. The specifics of dental treatment (care) services, i.e., high aerosol generation as well as close (about 50 cm) and prolonged (about 30–45 min.) contact between a dentist and patient, pose a high reciprocal risk of transmitting the infection because the virus spreads widely around the treatment site [3], i.e., it can spread to patients, doctors and assisting staff. Previous scientific studies [4–8] proved that viruses are widespread in dentists' work environment and revealed the threats posed to dental practitioners and their teams.

The specifics of dental procedures lead to the transmission of viruses through saliva, aerosols used for dental procedures and the time factor; these determinants all raise the risk of virus transmission and create an unsafe environment for both medical professionals and patients.

To protect themselves against the aforementioned viral risk factors, dentists typically use a variety of face masks and shields, respirators, goggles, disposable gloves and coats. Nevertheless, personal protection measures do not provide adequate respiratory protection against small aerosol particles [9]. For instance, while FFP3 respirators are 99% effective, they allow air to partially pass through the face covering to the nose and mouth. Prolonged use of disposable gloves or other disposable clothing may result in micro perforation and an increased exposure of skin to pathogens.

The variety of disinfection and sterilization products in the market is quite large. These products are mostly based on the use of particular technologies; integration of ultraviolet rays (UV-C), air ionizers and hydrogen peroxide in aerosols are the most popular. Most of the products available in the market are universal, but differ in their effectiveness and functionality, and are not limited to dental procedures.

2. Materials and Methods

2.1. Methodology for Evaluating the Competitive Products Available in the Market and the Ones under Development

Evaluation of the competitive products already available in the market or still under development is conducted in three stages, which are referred to as activity packets (AP) (Table 1).

Table 1. Methodology for evaluating the competitive products available in the market and those under development.

Stages	Activities	Activity Description
Stage I	Selection of the competitiveness evaluation methods	1.1. Analysis of the competitiveness methods 1.2. Adjusting the competitiveness methods with the customer
Stage II	Analysis of the major competitors	2.1. Identification of the competitive product manufacturers 2.2. Identification of the competitive products in the market 2.3. Analysis of the competitive products 2.4. Competitor segmentation
Stage III	Development of a new product launch strategy	3.1. Analysis of the product launch strategy and communication channels 3.2. Development of a new product launch strategy

Methods used for the analysis:

- Scientific literature analysis;
- Big data analysis;
- Analysis of the publicly available information.

The data for the analysis were extracted from the Bloomberg Laboratories [10].

2.2. Analysis of the Competitiveness Methods/Models

Traditional competitiveness analysis is based on customer needs and usually focuses on marketing strategies and their operationalization. In their marketing strategies, companies often differentiate products to understand and meet the diverse needs and expectations of their customers. When developing new products, it is particularly important to evaluate their competitive potential, to identify the major determinants of competitiveness, assess the potential risks and opportunities and evaluate their market position in relation to that of competitive products. Scientific literature is comparatively rich in competitiveness evaluation methods. The methods most commonly applied for evaluating competitiveness can be categorized as traditional (SWOT, Michael E. Porter's five forces

model, etc.) and based on application of mathematical modelling (e.g., structural equation modelling, a demand function).

Table 2 provides a review of the competitiveness evaluation methods, followed by descriptions of these methods.

Table 2. Review of the competitiveness evaluation methods.

Method	Description
SWOT	SWOT analysis is proposed to be applied from a customer perspective. Phadermrod et al.'s (2019) research revealed that this method allows identification of the SWOT factors that can be improved [11]. Amin et al. (2011) note that SWOT analysis can be used to develop a new decision-making tool to improve product competitiveness. The authors' research into the automotive parts sector confirmed that this tool can effectively present a product competition strategy [12].
M. E. Porter's five forces model	Lee et al. (2012) argue that product competitiveness can be analyzed by employing the five forces model. This method expands the potential of the product competitiveness analysis [13].
Modified M. E. Porter's five forces model	Jucevičius (1998) states that M. E. Porter's five forces model does not consider public institutions as a determinant of competitive advantage [14].
Structural equation model	The model focuses on the relationship between a brand and innovation in a particular industry. Brand marketing innovation is affected by brand competitiveness. Gupta et al. (2016) argue that innovation in brand marketing practices is affected by brand competitiveness [15].
Demand function	The function evaluates the degree of price competition determined by the size of a product's packaging. Smaller-sized product packaging strengthens price competition. Yonezawa and Richards (2016) [16].
System dynamics model	The model focuses on the competitive diffusion process of repurchased products. Products' market share depends on their time in the market and competitiveness. Yan and Ma (2011) [17].
Game model	The platforms explore market competition for untested new products and developed products. When the platforms receive a fixed share of revenue from all their vendors, the platforms and vendors expect new products to emerge. Hagiu and Wright (2020) [18].
Strategic group mapping	In a market with a large number of competitors, the competitive situation is assessed by dividing competitors into groups. Groups of competitors based on strategy similarities are referred to as strategic groups. Defining strategic groups allows identification of competing companies [19,20].
Growth share matrix	A growth share matrix for evaluating competitiveness was proposed by Boston Consulting Group (1970). The tool is designed to research and develop marketing strategies [21].
PricewaterhouseCoopers (PwC) industrial structure competition model	The model focuses on the market forces and their impact at the meso-economic level. It is argued that, with the interaction of the major key forces, such as public policies, technological growth and market signs (growth, trends), specific industrial sectors tend to thrive. This interaction creates the preconditions for responding to pressure from suppliers and buyers, as well as product and substitute competition [22].
Text mining	Bi et al. (2019) note that this method is designed to analyze the importance and effectiveness of online review products. The method provides rapid knowledge of product competitiveness [23]. Zhao et al. (2020) argue that this method allows the extraction of competitive insights from online reviews and comparison of different opinions [24]. The competitive insights gained from online reviews are helpful in improving product design. According to Xu et al. (2011), this method allows competing methods to be compared [25].

SWOT analysis. SWOT analysis is one of the first steps in a TOWS analysis. In a SWOT analysis, all strengths, weaknesses, opportunities and threats are analysed separately, whereas the TOWS matrix identifies the relationships between these four areas and selects strategies based on them. SWOT analysis is performed on an existing company to improve its efficiency and can also be used for assessing a new market or product; it comprises the external and internal analysis of a company's environment.

Strengths represent an internal factor which indicates what a company can undertake to achieve its strategic goals. When analyzing strengths, it is worth studying a company's

services or products, operational efficiency, team of specialists, management staff competences, processes, market size, financial capacity, available technology suppliers, etc.

Weaknesses represent an internal factor which indicates what can weaken a company's position and negatively affect the achievement of its strategic goals. Weaknesses can include outdated technologies, a lack of specialists, low employee motivation, a lack of managerial competences, bureaucratic and unclear internal processes, declining turnover, a lack of working capital, low market share, poor quality services or products, and so forth.

Opportunities represent an external factor which can be useful in achieving strategic goals. These may include economic growth, demographic changes, a favorable legal and political environment, the potential offered by technologies, and so forth.

Threats represent an external factor, also known as a barrier. Threats are the most difficult factor to control. They may include demographic changes, negative effects of the political and legal environment, the emergence of competitors, declining consumer purchasing power, and so forth.

Michael E. Porter's five forces model. One of the most popular and commonly used models for evaluating competitiveness is the 1990 Diamond model presented by the American scientist M. E. Porter. At the time, it was a relatively new approach to the concept of competitiveness in the global economy. It should be noted that this model is suitable for examining the competitiveness of a company, a country or an industry/segment. Porter's five competitive forces model proposes that competitiveness/profitability is determined by five major forces: threat of new entrants, bargaining power of suppliers, threat of substitution, bargaining power of buyers and competitive rivalry [26].

Over time, M. E. Porter's model of five competitive forces has been adjusted by different researchers depending on their field of research. Nevertheless, the vast majority of competitiveness analysis methods are still based on this model.

Modified M. E. Porter's five forces model**.** Scientific literature proposes that M. E. Porter's five forces model works well in a strong and stable economy [14]. This model is often criticized for disregard of public institutions and state regulation or technological progress as separate factors. Jucevičius improved the model by adding the role of public institutions. The author argues that competitiveness is affected by legal regulation and laws.

The structural equation model. Technological developments are driving innovation in marketing. The structural equation model for small and medium-sized enterprises (SMEs) was proposed by Gupta et al. Following an integrated approach, the authors sought to explore the relationship between competitiveness and innovation. The results of their study are relevant for both large manufacturing companies seeking to market their branded products and SMEs. To analyze the relationship between competitiveness and innovation, Gupta et al. invoked such research elements as brand competitiveness, reseller competitiveness and marketing innovation. Each of these elements covers several subelements [15].

The demand function. Yonezawa and Richards suggest including product package size as an element of product competitiveness. Product package size is an important element of marketing because the specific combination of package size and price determines a unit price which, in turn, has a significant impact on profitability of producers. Producers simultaneously choose the size and price of packaging. In practice, producers often reduce the size of a product while keeping the price of packaging the same, or reduce the size of a product while raising the price of packaging. Thus, a product unit price is rising when a product's package size is changing. The authors argue that product package size is a strategic variable for producers, especially if consumers prefer a certain package size. It is therefore presumed that, by competing on packaging size, producers can soften the degree of price competition in the market and raise profitability [16].

System dynamics model. Recently, technologies have been evolving so fast that their development cycles often exceed the lifespan of new products. New products often reach

the market already technologically obsolete; producers face strong competitive pressures or insufficient market acceptance, and are therefore unable to recoup the large amounts of capital invested in product development. With the rapid development of production technologies, various advanced production models are constantly emerging. Each newly proposed concept for advanced production reflects a new method of exploiting a typical production system. Since companies differ from one other, some may only need a single advanced production model, while others may require a few. Thus far, there been no advanced production system that can cover all the most advanced production models suitable for different types of companies. In addition, rapid changes in economic and business conditions, as well as constant changes in consumer preferences, have led to elevated market uncertainty, making information a critical factor. Yan and Ma note that this model is relevant for intelligent manufacturing. After developing competitive diffusion models, historical models and behavioral forecasts, historical data can be analyzed for future forecasting [17].

Game model. Hagiu and Wright note that many executives and investors believe it is possible to take advantage of the customer data potential to gain a competitive advantage. The more customers a company has, the more data it can accumulate. The data can be analyzed by employing machine learning methods. In this way, companies can get to know their customers better, offer better products and attract more customers. This is often the case for companies with a high network effect. Data-based businesses have been around for a long time. Collecting and using customer information to make better products and services is an old strategy, but in the past the process was slow, limited and difficult to expand. With the advent of new technologies that allow companies to process and perceive huge amounts of data quickly, the situation has changed. Internet-based products and services can now directly contribute to collection of information about customers, including their personal information, search behavior, content selection, communications, social media records, GPS location and product/service usage habits. Once machine learning algorithms have analyzed this 'digital emission', business offers can be automatically adjusted to reflect the findings and even tailored to particular individuals [18].

Hagiu and Wright suggest a model that allows evaluation of new, untested products and their vendors. For instance, a key strategic solution for platforms such as Airbnb, eBay and TaskRabbit is the extent to which they should facilitate the access to new, untested (i.e., risky) products and vendors, along with reliable (i.e., safe) products and vendors. The emergence of such products and vendors is important for the growth of these platforms, as they provide buyers with new choices that can sometimes prove to be better than the established products and vendors. However, researching these risky new products and vendors poses a public welfare problem with regard to current and potential customers [27].

Grow share matrix. The grow share matrix for measuring competitiveness was proposed by Boston Consulting Group. The tool is designed to research and develop marketing strategies. It allows the products in a company's portfolio to be classified by their competitive position in a particular industry. This model is often applied in practice because it allows companies to decide which products are worth investing in, considering their competitiveness and market attractiveness [21].

The growth share matrix consists of four parts (Stars, Cash Cows, Question Marks and Dogs) that represent a company's products and services. The indicators used for evaluation are a relative market share and the market demand growth. The information in the growth share matrix enables strategic investment decisions. Companies can see whether continuous investing in particular products or services is still relevant or whether it is more beneficial to suspend investment in particular segments and improve the strategic investment decisions. The growth share model focuses not on profit but on cash flows, because they determine business growth capacities [21].

Strategic group mapping. The concept of strategic groups was first introduced by Hunt. The matrix of strategic groups is particularly useful when certain hypotheses on the

business dimension's impact are available. By considering different aspects, critical success factors can be identified, and the position of a company or a product in relation to other industries can be assessed. Scientific literature suggests that if the number of competitors is sufficiently large, they can be attributed to particular groups. Groups are formed by evaluating corporate strategies. The groups of competitors following similar strategies can be recognized as strategic groups. Identification of strategic groups reveals competing companies. The intensity of competition between companies in one strategic group depends on the similarity of their strategies. The greatest competition is likely within groups, but it can also occur between groups. Some strategic groups may target the same consumer segments; consumers may not see the difference between the products offered by different strategic groups. M. E. Porter suggests the following principles for grouping competitors: characteristics (e.g., volumes and the number of distribution channels) should not correlate very closely with each other; it is appropriate to select the characteristics that best reflect the differences between competitors; it is better to select generalized than quantitative characteristics [19,20].

PricewaterhouseCoopers **(**PwC**)** industrial structure competition model. Mitkutė and Nagreckaitė researched the PwC industrial structure competition model. The authors conducted the analysis of the model based on the PwC General report. The model is based on M. E. Porter's five forces and the impact of the market forces at the meso-economic level. The major forces considered are public policies, technological growth and market characteristics (growth, trends, etc.). Due to interaction of the forces, a particular industry has the potential to develop if it can withstand the pressure from suppliers and buyers, as well as product and substitute competition [22].

Text mining. Jian-Wu Bi et al. published a scientific paper focused on the importance-performance analysis (IPA), based on online reviews and responses. This methodology comprises three stages: collecting useful information from online responses; assessing the importance of each attribute; and shaping the content of the IPA. It allows the assessment of how online text responses correlate with product rankings [23].

Resource-based competitiveness evaluation model. The COVID-19 pandemic has had a significant impact on industrial competitiveness. Ilinova et al. suggest evaluating the potential of competitiveness by employing the model that comprises market positioning and resource-based approaches. Application of the model identifies the factors of competitiveness arising from the internal and external corporate operating environment. The authors state that, when trying to identify new niches, it is relevant to focus on and exploit the potential that emerges during the crisis, and thus seek a sustainable competitive advantage [28].

3. Results

Based on scientific literature analysis and the insights into the issues of competitiveness evaluation, a method for evaluating the competitive products available in the market or under development is created. The method comprises three stages:

STAGE 1. Identification of a product's functional and technical characteristics, selection of the evaluation criteria (Figure 1).

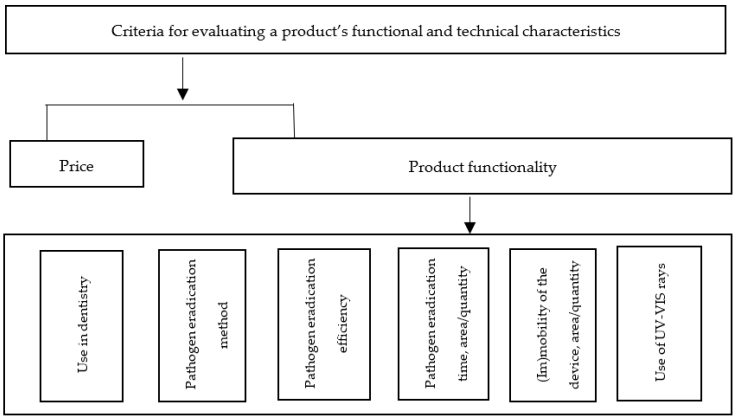

Figure 1. Criteria for evaluating a product's functional and technical characteristics.

STAGE 2. Overview of the competitive products and their producers in the market.
STAGE 3. Evaluation of the functional characteristics in the competitive products.

3.1. Identification of a Product's Functional and Technical Characteristics, Selection of the Evaluation Criteria

Selection of the characteristics and identification of the relevant criteria are based on information availability and quality.

3.2. Overview of the Competitive Products and Their Producers in the Market

Comparison of the competitive products and their producers by the key performance indicators: The analysis covered those producers of competitive products that offer modern and robotized indoor disinfection equipment.

'Xenex', with $150 million sales revenue, was the leader in 2020 compared to other companies that offer modern disinfection equipment. Meanwhile, 'Oz Robotics' had sales of less than $1 million. The average level of corporate sales revenue in 2020 was $22.5 million.

The analysis revealed that the prices of robotized disinfection equipment available in the market range from $345 to $125,000. The least expensive equipment is mainly intended for personal use, i.e., designed for natural persons with a lower need for disinfection of viruses, bacteria and fungi of various origin. Such equipment is smaller, intended for disinfecting much smaller areas, and its price is correspondingly lower. The price of robotized equipment intended for disinfecting large hospital or other common-use premises can reach up to $125,000, depending on power, the degree of modernity and the area to be disinfected. The average market price of such equipment is ~$42,000.

Depicts distribution of the modern robotized disinfection equipment available in the global market by price: The largest market shares are held by 'Xenex', 'Surfacide' and 'Tru-D'. Their dominant products are disinfection equipment with an integrated pulsed xenon: 'UV-C system' (15% of the market share), 'Surfacide Helios System' (23% of the market share) and 'Tru-D' smart UV-C disinfection system—a robot with the patented 'Sensor360®' technology (23% of the market share), respectively.

Comparison of the functional characteristics in the competitive products: The overview of the competitive products and their producers in the market allowed products' functional characteristics to be identified and then compared with analogues offered in the market. The review of competitive products in terms of their functionality is presented in Table A1, Appendix A.

The vast majority of competitive products are based on the use of UV-C shortwave ultraviolet radiation for surface and air disinfection with >99% pathogen eradication efficiency. Only a few products are based on other disinfection methods, e.g., the use of hydrogen peroxide vapor ('Bioquell' Q-10 hydrogen peroxide vapor (HPV) biological

decontamination system). The pathogen eradication duration and area may vary depending on the power and number of UVC lamps used in the products under consideration. Devices are usually designed to perform a specific disinfection function and are supplied as finished products that cannot be integrated into other devices [29].

Only the 'Solar Light Company, Inc.' product NIST-Traceable PMA-Series UVC Sensor is integrable, while all other products under consideration cannot be integrated into other systems and are intended to be used separately. The purpose of competitive products is comparatively diverse. Most are intended for use in medical premises (hospitals, operating rooms, laboratories), dental offices and common-use premises. None use the High Intensity Narrow Spectrum (HINS) light spectrum. Although some devices can be rented for a certain number of hours or times of use, most need to be purchased, with prices ranging from $345 (for individual point use) to $125,000 (for the entire room).

3.3. Evaluation of the Functional Characteristics of the Competitive Products

Considering the above-presented review of competitive products, quantitative comparison of their functional characteristics was based on identification of the eight key characteristics most frequently requested by dental service providers in the context of the COVID-19 pandemic [30]:

- Their use in dental service provision, taking into account the convenience and applicability of a product;
- Integration of UV-C radiation into a device;
- Protection against pathogens of various origin (viruses, bacteria, fungi, including COVID-19 virus);
- Pathogen eradication efficiency, i.e., percentage of pathogen eradication;
- Pathogen eradication duration, i.e., time during which medium-sized premises are disinfected (20–30 m^2 disinfection);
- Levels of barrier protection against COVID-19 virus (patient saliva ejection protection; protection against COVID-19 virus during aerosol-generating procedures; exhaled air protection function);
- Potential of integration with other devices;
- HINS light integration.

Based on the review of the competitive products and their relevant functional characteristics, the products already available in the market and a new Lithuanian product under development were evaluated in terms of their functionality. The top five competitive products are shown in Table 3, with the full results of the evaluation provided in Table A2, Appendix A. The score values corresponding to the maximum (1) and minimum (5) evaluation of each functionality characteristic revealed a variation in the functionality of the products that are already available in the market and highlighted the need for an optimal combination of the functionality characteristics in dentistry responding to the challenges of the COVID-19 pandemic [31].

Table 3. Summary of the rankings provided to the functional characteristics of the competitive products (on the scale from 1 to 5, where 1 = very bad and 5 = very good).

Producer/ Country	Product	Use in Dental Service Provision	Integration of UV-C Radiation into a Device	Protection against Pathogens of Various Origin (Including COVID-19 Virus)	Pathogen Eradication Efficiency	Pathogen Eradication Duration	Levels of Barrier Protection against COVID-19 Virus	Potential of Integration with Other Devices	HINS Light Integration	Total
Lithuania	Product under development	5	5	5	5	5	5	5	5	40
'Honeywell International Inc.', International	Honeywell UV processing system	2	5	5	5	4	2	1	1	25

Conglomerate/USA										
'Radic8 Limited'/Great Britain	Viruskiller™	5	5	5	5	5	2	1	1	29
'BlueBotics'/Switzerland	Mini™ UVC robot	5	5	5	5	4	2	1	1	28
'Digital Light Lab'/USA	AccuCure ULM-6 Spot product	1	5	2	4	4	2	1	1	20

Most of the products already available in the market received maximum or average ratings in terms of their applicability to dental services, integration of UV-C radiation, protection against pathogens of various origin, eradication duration and efficiency. Nevertheless, the products under consideration generally provide only one protection barrier in terms of COVID-19 virus prevention, i.e., they disinfect the air exhaled by a patient or dental water (e.g., 'Sterisil Ac+'). In addition, none of the products use HINS rays. This all serves to justify the uniqueness and innovativeness of a newly developed product which is going to integrate multi-level protection functions and innovative technologies (HINS rays) in terms of COVID-19 virus prevention [32].

The market segmentation process involves identifying the relevant segmentation characteristics and target segments and establishing a positioning strategy. Marketing segmentation studies allow the demographic profile of a product user, choice priorities and the problems faced by the target group to be identified. It also shows how users evaluate the product, what channels they use to purchase the product, how to attract attention of the target group, how important the brand is to a user, and so forth. Market segmentation is the division of the market into separate groups of users according to their needs, features and behavioral characteristics. Attractiveness of a market segment is assessed based on the following criteria: segment size, segment growth rate, intensity of competition, stability and economies of scale [33]. Market segmentation for the product under development is provided in Table 4. The product is expected to be used by business companies.

Table 4. Market segmentation for the product under development.

Activity Area	Geographical Area	Consumption Intensity	Company Size	Product Application
Dentistry	EU	Used in service provision on a continuous basis	SMEs	Specific application in dental service provision
Cosmetology	EU	Used in service provision on a continuous basis	SMEs	Specific application in cosmetology service provision

4. Discussion and Conclusions

The COVID-19 pandemic has highlighted not only the risk of infectious diseases, with a clear impact on dentists, their assistants and patients, but also a shortage of innovative products and their combinations that would successfully prevent the spread of COVID-19.

The review of competitive products and their producers revealed that the vast majority of the products available in the market are manufactured in the USA and are based on the use of UV-C shortwave ultraviolet radiation for surface and air disinfection with >99% pathogen eradication efficiency; the duration and area of pathogen eradication may vary, depending on the power and number of UVC lamps. Devices are usually designed

for a specific disinfection function (air, water) and delivered as finished products without the possibility of integration with other devices.

The review of competitive products and quantitative comparison of their characteristics identified eight major product functionality characteristics: their use in dental service provision; integration of UV-C radiation; protection against pathogens of various origin; pathogen eradication efficiency; pathogen eradication duration; levels of barrier protection against COVID-19 virus; potential of integration with other devices; and HINS light integration. Comparative evaluation of the competitive products' functional characteristics highlighted the need for a more efficient combination of the functionality characteristics than is currently available in the market. This justifies the uniqueness and innovativeness of a newly developed product which will integrate multi-level protection functions and innovative technologies in terms of COVID-19 virus prevention.

The major characteristics of the products are as follows:

Strengths:

Eradication of viruses and bacteria of various origin;
The efficiency of the devices is higher than 99%.

Weaknesses:

Non-mobility of part of a device;
Lack of integration with other devices;
The vast majority of the products under consideration are versatile and have the function of eradicating viruses around premises and in the absence of people.

Threats:

Rapidly evolving technologies and scientific developments contribute to emergence of new modern products in the market.

Opportunities:

Wide range of applications.

The newly developed product will possess the following advantages:

The product's design and purpose will be geared towards preventing the virus from entering the environment;
The virus will be eradicated in an enclosed space without human contact and will allow regular provision of services;
The product will be highly efficient, tested under laboratory conditions.

The market segment of the newly developed product covers the range of services provided by dentists, cosmetologists and ENT physicians. It will focus on small and medium-sized enterprises and specialized units of large enterprises.

The newly developed product is intended for continuous use.

In light of the analysis of the market penetration and communication of the products that are already available, the newly developed product will be promoted by employing the following measures:

- Scientific articles
- Articles/reports in media
- Articles/reports in professional issues
- Social network profiles (Facebook, Instagram, Twitter, LinkedIn)
- Product website
- Participation in exhibitions
- Direct contacts/meetings/presentations with potential buyers

In the context of the global pandemic, all products developed for managing the effects of the pandemic automatically enter the global market or experience faster market entry.

Author Contributions: Conceptualization, V.G., R.Č.; methodology, V.G., R.Č.; software, G.Ž., R.J.; validation, G.Ž., R.J. and B.K.; formal analysis, B.K.; investigation, V.G., R.Č.; resources, Y.-X.T.; data curation G.Ž., R.J.; writing—original draft preparation, V.G., R.Č., G.Ž., R.J.; writing—review and editing, B.K., Y.-X.T.; visualization, G.Ž., R.J., B.K., supervision, Y.-X.T.; project administration, V.G.; funding acquisition, Y.-X.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Ministry of Education and Science of Ukraine, grant number 0121U100470.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Review of the competitive products by functionality characteristics (created by authors based on [10,34–36]).

Producer/ Country	Product	Functionality Characteristics									
		Is the Device Used in Dental Practices?	Pathogen Eradication Method	Types of Eradicated Pathogens	Pathogen Eradication Efficiency	Pathogen Eradication Duration/Area/Quantity	Is the Device Mobile?	Can the Device Be Integrated into Other Devices?	Purpose	Is the HINS Light Spectrum Used?	Price
'Honeywell International Inc.', International Conglomerate/USA	Honeywell UV processing system	No	UV-C (254 nm)	Viruses of various origin, including SARS-CoV and MERS CoV.	>99%	The cabin of a medium-sized aircraft is disinfected in ~10 min.	Yes	No	Aircraft, vehicles, common areas	No	Rent from $10 (price varies depending on duration and intensity of the use)
'Radic8 Limited'/Great Britain	Viruskiller™	Yes	UV-C	Viruses, molds, bacteria, allergens, etc. of various origins	99.99%	60–165 m^2	No	No	Medical premises (operating rooms, laboratories, dental offices, etc.), common areas	No	$345–8659 (depending on area)
'BlueBotics'/Switzerland	Mini™ UVC robot	Yes	UV-C (253.7 nm)	Viruses, bacteria, fungi of various origin	>99%	Disinfection of surfaces at a distance of 1 m and a speed of 4.2 m/min.	Yes	No	Hospitals, airports, public facilities	No	$7757
'Digital Light Lab'/USA	AccuCure ULM-6 Spot product	No	UV-C (265–470 nm)	Viruses of various origin	>99%	No data	No	No	Used for integration into other devices, the application is wide	No	From $995

'Solar Light Company, Inc.'/USA	NIST-Traceable PMA-Series UVC Sensor	No	UVC intensity <1500 uW/cm^2	Viruses, bacteria, fungi of various origin	>99%	No data	No	Yes	Hospitals, common areas	No	$8920
'Prescientx'/Canada	SanUVox ASEPT.2X Mobile UV	Yes	UV-C	Viruses, bacteria, fungi of various origin	99.99%	No data	Yes	No	Hospitals, medical offices, common areas	No	$35,000
'Sterisil Inc.'/USA	Sterisil Ac+ (autoclave system)	Yes	UV-C (Class B); distilled quality water with <10 ppm TDS	Viruses, bacteria of various origin	99%	50 l/day of distilled quality water	No	Yes	Medical premises, dental offices	No	$1833
'Surfacide LLC'/USA	Surfacide Helios System	Yes	UV-C	Viruses of various origin (including SARS-CoV-2 and COVID-19), bacteria (C. diff, MRSA, VRE, CRE, Acinetobacter, etc.)	99.99%	A medium-sized room is disinfected in <20 min.	Yes	No	Hospitals, hotels, other common areas	No	From $10,000 to $125,000 (depending on the system complexity)
'Light Progress'/Italy	UVGI air purifiers	Yes	UV-C (pure quartz without ozone 254 nm)	Viruses, bacteria of various origin	99.99%	24 h; the air in the room can be cleaned daily without any contraindications for people staying in the room.	Yes	No	Medical premises, common-use premises	No	$1707
'Xenex Disinfection Services LLC'/USA	Disinfection equipment with integrated pulsed xenon UV-C system (Pulsed Xenon Disinfection Product)	Yes	Pulsed xenon UV-C system LightStrike (200–315 nm)	Viruses (including COVID-19) and bacteria of various origin	99.99%	No data	Yes	No	Aircraft, medical and general-use premises (especially during the COVID-19 pandemic)	No	$81,000
'Tru-D Smart UVC'/USA	Tru-D smart UV-C disinfection system–robot	Yes	UV-C	Viruses of various origin, including Ebola,	99%	Average duration of the disinfection cycle is 15–35 min.	Yes	No	Medical premises, common-	No	$125,000

	with patented Sensor360® technology (Tru-D Smart UV-C)			Staphylococcus aureus (MRSA), Clostridium difficile (C. diff), MERS, Norovirus, Enterovirus D68					use premises		
'Bioquell PLC'/Great Britain	Bioquell Q-10 hydrogen peroxide vapor (HPV) biological decontamination system	Yes	Use of hydrogen peroxide vapor	Viruses, bacteria, fungi, spores of various origin	No data	Premises up to 250 m^3	Yes	Yes	Medical premises, common-use premises	No	$47,000
'Oz Robotics'/USA	Oz Robotics M01-UVC disinfection autonomous mobile robot (AMR)	Yes	UV-C	Viruses, bacteria of various origin	99.9%	25 m^2 rooms are disinfected in 10 min.	Yes	No	Medical premises, common-use premises	No	$50,000

Table A2. Summary of the rankings provided to the functional characteristics of the competitive products (on a scale from 1 to 5, where 1 = very bad and 5 = very good).

Producer/ Country	Product	Use in Dental Service Provision	Integration of UV-C Radiation into a Device	Protection against Pathogens of Various Origin (Including COVID-19 Virus)	Pathogen Eradication Efficiency	Pathogen Eradication Duration	Levels of Barrier Protection against COVID-19 Virus	Potential of Integration with Other Devices	HINS Light Integration	Total
Lithuania	Product under development	5	5	5	5	5	5	5	5	40
'Honeywell International Inc.', International Conglomerate/USA	Honeywell UV processing system	2	5	5	5	4	2	1	1	25
'Radic8 Limited'/Great Britain	Viruskiller™	5	5	5	5	5	2	1	1	29
'BlueBotics'/Switzerland	Mini™ UVC robot	5	5	5	5	4	2	1	1	28

'Digital Light Lab'/USA	AccuCure ULM-6 Spot product	1	5	2	4	4	2	1	1	20
'Solar Light Company, Inc.'/USA	NIST-Traceable PMA-Series UVC Sensor	1	5	3	4	4	2	4	1	24
'Prescientx'/Canada	SanUVox ASEPT.2X Mobile UV	5	5	5	5	4	2	1	1	28
'Sterisil Inc.'/USA	Sterisil Ac+ (autoclave system)	5	4	4	3	2	2	3	1	24
'Surfacide LLC'/USA	Surfacide Helios System	4	5	5	5	4	2	1	1	27
'Light Progress'/Italy	UVGI air purifiers	5	5	3	5	4	2	1	1	26
'Xenex Disinfection Services LLC'/USA	Disinfection equipment with integrated pulsed xenon UV-C system (Pulsed Xenon Disinfection Product)	4	5	5	5	4	2	1	1	27
'Tru-D Smart UVC'/USA	Tru-D smart UV-C disinfection system—robot with patented Sensor360® technology (Tru-D Smart UV-C)	4	5	4	5	5	2	1	1	27
'Bioquell PLC'/Great Britain	Bioquell Q-10 hydrogen peroxide vapor (HPV) biological decontamination system	5	1	2	2	4	2	2	1	19
'Oz Robotics'/USA	Oz Robotics M01-UVC disinfection autonomous mobile robot (AMR)	5	5	3	5	5	2	1	1	27

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