Universidad de Valladolid

Escuela de Doctorado Universidad de Valladolid

PhD PROGRAMME IN HEALTH SCIENCES RESEARCH

PhD:

SOCIAL MEDIA IN DERMATOLOGY: A STUDY ABOUT HOW TO VISIBILIZE EVIDENCE-BASED CHANNELS, THROUGH A REAL-LIFE EXPERIENCE

Presented by Leire Barrutia Etxebarria to opt for
the degree of
PhD Doctor by the Universidad of Valladolid

Supervised by:
Dr. Jesús Vega Gutiérrez
Dr. Alba Santamarina Albertos

Universidad de Valladolid

Escuela de Doctorado Universidad de Valladolid

PROGRAMA DE DOCTORADO EN INVESTIGACIÓN EN CIENCIAS DE LA SALUD

TESIS DOCTORAL:

REDES SOCIALES EN DERMATOLOGÍA: ESTUDIO DE CÓMO VISIBILIZAR LOS CANALES BASADOS EN LA EVIDENCIA CIENTÍFICA, A TRAVÉS DE UNA EXPERIENCIA REAL

Presentada por Leire Barrutia Etxebarria para optar al grado de
Doctor/a por la Universidad de Valladolid

Dirigida por:
Dr. Jesús Vega Gutiérrez
Dra. Alba Santamarina Albertos

Acknowledgments

I would like to thank my supervisors Jesús Vega Gutiérrez and Alba Santamarina Albertos for their guidance and support throughout the course of this research project. Their expertise and insights have been instrumental in shaping the direction of this work, and I am grateful for the time and effort they have dedicated to it. I would also like to thank my tutor Antonio Dueñas Laita.

Finally, I would like to thank my partner, family, and friends for their love and support throughout these years. Specially, a warm thank you to my parents for inspiring me to embark on a PhD, to my sister for being my companion in the adventures of medicine and dermatology, and to my partner for sharing my dreams and for his endless belief in me. Their encouragement and understanding have been a constant source of strength and motivation. I am deeply grateful to them all.

CONTENTS

Summary

The presence of dermatological information on the internet has grown exponentially over the last two decades. In recent years, that growth has mostly occurred in social media platforms. Patients increasingly turn to these networks to search for dermatological information and share advice on dermatological matters with each other. The broad and constantly growing search for dermatological information online has risen concerns about the quality of this information, which many studies have proven to be misleading or even harmful. The reason behind the mediocre grade of the information is mainly that most content is produced by individuals without any dermatological training. Social media has also proven to be an interesting resource for dermatologists. Apart from providing the opportunity to counterpart misinformation and engage in health promotion, social media constitutes an asset for dermatologists for continuous medical education, medical research, marketing and social networking. However, although social media use is becoming increasingly prevalent amongst dermatologists, it is still a controversial practice. The main concerns are patient confidentiality, and legal and ethical issues.

This background raises the following questions: What are all the advantages of social media use by dermatologists? Can it provide more benefits than the most well-known ones? What are all the drawbacks of these platforms? What strategies have been identified to bypass them? Can we design practical strategies that harness their advantages and counteract their drawbacks? How does a real-life dermatologist profile on social media perform, and how can we optimize this performance and successfully have a positive impact on patient wellbeing and quality of life? Gaining deeper insights on all these matters is critical for developing a successful approach for dermatological presence on social media. The aim of this thesis is to provide answers to these research questions.

Therefore, as an initial theoretical approximation to the problem, the first part of this thesis consists on a thorough, systematic review of the literature that assembles the benefits, drawbacks and challenges that social media platforms present for dermatologists. A comprehensive systematic review was performed, dating from inception to July 2021. Finally, 161 articles were included. Fifteen benefits, eleven drawbacks and ten challenges of social media use in dermatology were identified and discussed. Suggested strategies to address the identified drawbacks were provided.

The remaining issues were addressed empirically. To make that possible, an educational dermatological YouTube channel was launched. The channel was designed to avoid the risks and ethical challenges that social media involves for dermatologists. A new video was launched weekly. After a three-year period, the channel has reached over 355,000 subscribers and 21 million views. 210 videos have been posted about a wide variety of dermatological topics, including acne, rosacea, melasma, psoriasis, hair loss, nevi, sun protection, melanoma, and active ingredients in cosmetics.

As the limited presence of dermatologists on social media has been criticized for focusing on cosmetic dermatology and not representing the role of dermatologists accurately, the first experiment of this thesis was designed to find out whether there was a difference in the visibility of topics related to cosmetic dermatology and topics related to the medical fields of dermatology. For that purpose, the 101 videos published in a two-year period were divided into cosmetic (51 videos) and medical dermatology (50 videos). Student's t-test was conducted to determine whether there were significant differences in views. Medical dermatology videos were then classified into three categories: Acne, facial dermatoses (excluding acne) and other dermatological diseases. This subcategorization was performed because it was apparent that there was a great variance in views within this category. A Kruskal-Wallis test was used to compare these three categories and cosmetic dermatology. When comparing cosmetic and medical dermatology, no significant differences were found. When comparing the four categories, cosmetic dermatology and acne were found to generate significantly more views that other dermatological diseases. Therefore, this study concluded that the public seems to be particularly interested in cosmetic dermatology and acne. This might make it challenging to become successful on social media while presenting a balanced portray of dermatology. However, focusing on popular topics can provide a real chance to be influential and protect vulnerable people from misinformation.

The second experiment of this thesis was designed to gain insight on how to optimize the performance of dermatological content on social media and successfully have a positive impact on patient wellbeing and quality of life. As well as focusing on topics that the audience finds interesting, in order to have an impact and successfully perform dermatological health promotion, dermatologists should create content that retains the public's attention. Consequently, this experiment focused on audience retention on YouTube and its explanatory factors. To our knowledge, it is the first study in dermatology that focuses on audience retention

on YouTube. Audience retention is essential for two reasons. First, it is a necessary condition to ensure viewers' proper understanding of the video content and, therefore, to achieve positive behavioural changes. Second, the YouTube algorithm takes audience retention into consideration to rank each video. The smaller the audience retention of a video, the lower the video ranking, which implies that the video is not presented to potential viewers and thus cannot have the intended impact.

YouTube presents information on audience retention in the form of a graph. Interestingly, the middle section of the video may show some spikes and dips Spikes appear when viewers focus on specific parts of the video. This can be in the form of selective watching, re-watching or sharing this specific content with others. They indicate that some parts of a video are particularly interesting for viewers and thus justify closer examination. Data from the 137 videos published during the studied period (2 years and 9 months) was included. The spikes of all the videos included in the study were identified, and their content was analysed to determine what was particularly interesting for viewers. As the videos were educational, spikes were classified into conceptual or procedural knowledge. The average audience retention of the videos was 41.69%. Video length and days from release had a negative effect on audience retention, with the effect of video length ($\beta = -.6979$; $p = .0000$) being strong and that of days from release being weak ($\beta = -.023$; $p = .0000$). Spikes were observed in 76 videos (55.47%), 68.15% of which were classified as procedural. Therefore, the data obtained in this experiment indicate that audience retention increases as video length decreases, and that viewers are essentially interested in practical information. Consequently, this study concluded that, to increase audience retention, dermatologists should design succinct videos and deliver procedural knowledge that creates value for the public.

This thesis encompasses the first research about dermatology on social media that uses a broad-scale primary source. While performing research from primary sources is the tradition of scientific research in dermatology, in the case of social media, previous contributions rely on secondary sources and conceptual developments. The studies performed in this thesis have provided answers to gaps identified in the previous literature, and have supplied practical resources to optimize health promotion performed by dermatologists on social media platforms.

Resumen

La presencia de información dermatológica en internet ha crecido exponencialmente en las dos últimas décadas. En los últimos años, ese crecimiento se ha producido sobre todo en las redes sociales. Los pacientes recurren cada vez más a estas redes para buscar información dermatológica y compartir consejos sobre cuestiones dermatológicas entre ellos. La amplia y creciente búsqueda de información dermatológica en internet ha suscitado una preocupación por la calidad de esta información. Muchos estudios previos indican que esa información es engañosa o incluso perjudicial. La baja calidad de la información deriva de que la mayoría de los contenidos son elaborados por personas sin formación dermatológica. Las redes sociales han demostrado, asimismo, ser un recurso interesante para los dermatólogos. Además de ofrecer la oportunidad de contrarrestar la desinformación y participar en la promoción de la salud, las redes sociales constituyen un activo para los dermatólogos en lo que respecta a la formación médica continuada, la investigación médica, el marketing y las redes sociales. Aunque el uso de las redes sociales es cada vez más frecuente entre los dermatólogos, sigue siendo una práctica controvertida. Las principales preocupaciones son la confidencialidad del paciente y las cuestiones legales y éticas.

Estos antecedentes plantean las siguientes preguntas: ¿Cuáles son las ventajas del uso de las redes sociales por parte de los dermatólogos? ¿Puede aportar algunos beneficios diferentes a los habitualmente citados? ¿Cuáles son los inconvenientes de estas plataformas? ¿Qué estrategias se han identificado para sortearlos? ¿Podemos diseñar estrategias prácticas que maximicen sus ventajas y contrarresten sus inconvenientes? ¿Cómo funciona el perfil de un dermatólogo en las redes sociales en la vida real, y cómo podemos optimizarlo para que repercuta positivamente en el bienestar y la calidad de vida de los pacientes? Para desarrollar un enfoque exitoso de la presencia dermatológica en las redes sociales es fundamental disponer de respuestas en profundidad a todas estas cuestiones. Consecuentemente, el objetivo de esta tesis es dar respuesta a estas preguntas de investigación.

Como aproximación teórica al problema, la primera parte de esta tesis consiste en una revisión exhaustiva y sistemática de la literatura que integra los beneficios, inconvenientes y retos que las redes sociales presentan para los dermatólogos. Se realizó una revisión sistemática y exhaustiva de la literatura, que analizó desde las primeras publicaciones hasta julio de 2021.

Finalmente, se incluyeron 161 artículos. Se identificaron y discutieron quince beneficios, once inconvenientes y diez desafíos del uso de las redes sociales en dermatología. Se sugirieron estrategias para abordar los inconvenientes identificados.

Las cuestiones restantes se abordaron empíricamente. Para hacerlo posible, se puso en marcha un canal dermatológico educativo en YouTube. El canal se diseñó para evitar los riesgos y los retos éticos que las redes sociales implican para los dermatólogos. Cada semana se lanzaba un nuevo vídeo. Después de tres años, el canal ha alcanzado más de 355.000 suscriptores y 21 millones de visitas. Se han publicado 210 vídeos sobre una amplia variedad de temas dermatológicos, como el acné, la rosácea, el melasma, la psoriasis, la caída del cabello, los nevus, la protección solar, el melanoma y los principios activos de los cosméticos.

Dado que la (escasa) presencia de dermatólogos en las redes sociales ha sido criticada por centrarse en la dermatología cosmética y no representar fielmente el papel de los dermatólogos, el primer experimento de esta tesis se diseñó para averiguar si existía una diferencia en la visibilidad de los temas relacionados con la dermatología cosmética y los temas relacionados con los campos médicos de la dermatología. Para ello, los 101 vídeos publicados en un periodo de dos años se dividieron en dermatología cosmética (51 vídeos) y dermatología médica (50 vídeos). Se realizó una prueba t de Student para determinar si había diferencias significativas en las opiniones. Posteriormente, los vídeos de dermatología médica se clasificaron en tres categorías: Acné, dermatosis faciales (excluido el acné) y otras enfermedades dermatológicas. Esta subcategorización se realizó porque era evidente que había una gran varianza en las visualizaciones dentro de esta categoría. Se utilizó la prueba de Kruskal-Wallis para comparar estas tres categorías y la dermatología cosmética. Al comparar la dermatología cosmética y la médica, no se encontraron diferencias significativas. Al comparar las cuatro categorías, se observó que la dermatología cosmética y el acné generaban muchas más visitas que otras enfermedades dermatológicas. Por tanto, este estudio concluyó que el público parece estar especialmente interesado en la dermatología cosmética y el acné. Esto puede dificultar el éxito en las redes sociales cuando se intenta presentar una imagen equilibrada de la dermatología. Sin embargo, centrarse en temas populares puede proporcionar una oportunidad real de ser influyente y de proteger a las personas vulnerables de la desinformación.

El segundo experimento de esta tesis se diseñó para obtener información sobre cómo optimizar el rendimiento del contenido dermatológico en las redes sociales y lograr un impacto positivo en el bienestar y la calidad de vida de los pacientes. Además de centrarse en temas que resulten interesantes para la audiencia, para tener impacto y llevar a cabo con éxito la promoción de la salud dermatológica, los dermatólogos deben crear contenidos que retengan la atención del público. Por ese motivo, este segundo experimento se centró en la retención de la audiencia en YouTube y sus factores explicativos. Hasta donde sabemos, es el primer estudio en dermatología que se centra en la retención de la audiencia en YouTube. La retención de la audiencia es esencial por dos razones. En primer lugar, es una condición necesaria para garantizar la correcta comprensión del contenido del vídeo por parte de los espectadores y, por tanto, para lograr cambios de comportamiento positivos. En segundo lugar, el algoritmo de YouTube tiene en cuenta la retención de audiencia para clasificar cada vídeo. Cuanto menor sea la retención de audiencia de un vídeo, menor será su calificación, lo que implica que el vídeo no se presentará a los espectadores potenciales y, por tanto, no podrá tener el impacto previsto.

YouTube presenta la información sobre la retención de audiencia en forma de gráfico. Los llamados *spikes* o picos de retención aparecen cuando los espectadores se centran en partes específicas del vídeo. Esto puede adoptar la forma de visualización selectiva, repetición de la visualización o compartir este contenido específico con otras personas. Los picos indican que algunas partes de un vídeo son especialmente interesantes para los espectadores y, por tanto, justifican un análisis más detenido. Se incluyeron datos de los 137 vídeos publicados durante el periodo estudiado (2 años y 9 meses). Se identificaron los picos de todos los vídeos incluidos en el estudio y se analizó su contenido para determinar qué resultaba especialmente interesante para los espectadores. Como los vídeos eran educativos, los picos se clasificaron en conocimiento conceptual o procedimental. La retención de audiencia media de los vídeos fue del 41,69%. La duración del vídeo y los días transcurridos desde su estreno tuvieron un efecto negativo en la retención de la audiencia, siendo fuerte el efecto de la duración del vídeo (β = -,6979; p = 0,0000) y débil el de los días transcurridos desde su estreno (β = -,023; p = 0,0000). Se observaron picos en 76 vídeos (55,47%), de los cuales el 68,15% se clasificaron como procedimentales. Por lo tanto, los datos obtenidos en este experimento indican que la retención de la audiencia aumenta a medida que disminuye la duración del vídeo, y que los espectadores están esencialmente interesados en la información práctica. En consecuencia, este estudio

concluye que, para aumentar la retención de la audiencia, los dermatólogos deben diseñar vídeos sucintos y ofrecer conocimientos procedimentales que creen valor para el público.

Esta tesis engloba la primera investigación sobre dermatología en las redes sociales que utiliza una fuente primaria de amplio alcance. Mientras que la investigación a partir de fuentes primarias es la tradición de la investigación científica en dermatología, en el caso de las redes sociales, las contribuciones anteriores se basan en fuentes secundarias y desarrollos conceptuales. Los estudios realizados en esta tesis han aportado respuestas a lagunas identificadas en la literatura previa, y han proporcionado recursos prácticos para optimizar la promoción de la salud realizada por los dermatólogos en las redes sociales.

PART I
INTRODUCTION

1. Background

1.1 The impact of digital transformation in medicine

Digital transformation has impacted every facet of society and science. In the case of medicine, this impact has been profound and has affected many different aspects, such as health care and medical practice, academic medicine and medical education, research, patient education and health promotion campaigns.

In the case of medical practice, innovative health care technologies have opened a path toward personalized, patient-centric medicine (Wu et al., 2022). Additionally, tele-medicine has given rise to patient-doctor communication and health care problem solving strategies that surpass time and geographical restrictions (Bhaskar al., 2021). Regarding medical education, artificial intelligence and machine learning have brought about new tools and e-learning methods, and social media platforms have allowed a more fluent communication between students and teachers (Althubaiti et al., 2022; Lattouf et al., 2022). Respecting medical research, internet medical data has prompted big-scale research, and online communication through social media has facilitated international collaboration (Zheng, Mulligan et al., 2021). As for health promotion, social media platforms provide a unique tool to communicate information to millions of users, and comprise a more cost-effective option for health-promotion campaigns than traditional approaches (De la Garza et al., 2021; Correia et al., 2018). Concerning patient education, the internet has provided patients with an additional way of accessing health care information different from consulting a doctor, switching the role of patients in health care from a passive to a more active role (Gantebein et al., 2020).

Social media platforms have developed and grown immensely in the last two decades, and they have been the central drivers of the majority of the changes described above, as they have transformed the interaction and communication among doctors and among patients, provided data for research, and removed barriers from the accessibility to medical information (George et al., 2012; Edosomwan et al., 2011).

In this progressive but rampant evolution of social media platforms, the COVID-19 pandemic has been a catalyser that has maximised their spread and has established them as a

cornerstone in health care (Garfan et al., 2021). For that reason, at this point, it is essential to systematically analyse their impact and their potential uses, and understand their drawbacks.

1.2 Paradigm shifts in Dermatology derived from the use of social media

The presence of dermatological information on the internet has grown exponentially over the last two decades (George et al., 2012). In recent years, that growth has mostly occurred in social media platforms (Gantenbein et al., 2020; Croley et al., 2019; Carlquist et al., 2018). Social media refers to web-based tools and mobile technologies that allow people to connect and share information regardless of geographical and time barriers (Benabio et al., 2013). The most popular social networks nowadays are YouTube, Instagram, TikTok, Facebook and Twitter, and each of them has differential features in the type of information that can be shared through them (Taberner, 2016; Statista, 2021). The most attractive and useful feature of social media platforms is their accessibility, immediacy and shareability, and the way in which they provide information through images and videos, making it more entertaining and engaging (DeBord et al., 2019). This type of content makes it ideal to share information of a medical specialty as visual as dermatology (Udey et. al, 2020). Thus, the amount of dermatological information on these sites is vast. For example, in March 2021 there were 334 million cumulative views related to isotretinoin on TikTok (Zheng, Ning et al., 2021).

Patients increasingly turn to the internet to search for dermatological information and share advice on dermatological matters with each other (Sun et al., 2021; Janda et al., 2020; Vasconcelos et al., 2020). In 2020, more than 72% of adults in the United States and 75% of Europeans looked for healthcare information online. These numbers are even higher amongst younger internet users, who predominantly access social media platforms (Schuster et al., 2020). Some studies have concluded that social networks are patients' preferred source of dermatological information. A survey-based cross-sectional study carried out at two Dermatology departments in Switzerland in 2020 (Gantenbein et al., 2020) found that 82.4% of patients searched the internet for medical information, and that 65.4% were users of social media. Patients mainly accessed Google (42.3%), followed by YouTube (34.6%), and Facebook (22.3%), and less frequently searched on Instagram (5.4%). Among dermatological patients, the subgroup that looked up dermatological information more frequently were women,

patients with a higher level of education, higher income, higher dermatological burden and a higher level of anxiety. The main motivations for searching dermatological information online were to obtain better understanding of the disease, to learn about the experience of other patients, for self-diagnosis and treatment, and to find alternative therapies. The main benefits that patients saw in using social media for their dermatological problems instead of seeing a dermatologist were the relative ease of searching online, lower cost, and shorter wait time. 35.4% did not think they needed to see a dermatologist, and 3.1% did not trust their dermatologist.

In regard to the topics that patients search the most, an online survey carried out in 2019 found that they are mainly interested in skincare products, anti-aging, hair products, acne and sun protection. Many other studies have also found that acne is the most searched for dermatologic disease (Guzman et al., 2020; Young et al., 2021; Drozdowski et al., 2021). This makes sense because it affects approximately 85% of teenagers, the population that is most active on social media (Guzman et al., 2021). In contrast, a survey carried out Switzerland in 2020 (Gantenbein et al., 2020) found that social media use was negatively associated with acne. This seems contradictory, and the explanation that the authors found for it is that acne is a very commonly known disease for which patients might need less research. However, it does not go in line with the rest of the studies in literature, and another explanation might be that the population of this study did not represent the group of patients that normally use social media. In fact, mean age was 45 years old, and 78% stated that they only spent 0 to 2 hours a day on social media (Gantenbein et al., 2020).

A content analysis carried out in the biggest dermatological forum on Reddit in 2019 (Wong et al., 2019) found that the four major topics were advice on routines and products (33%), general discussions on skin health and wellbeing (39%), impact of skin ailments and their treatment options (14%), and social concerns in relation to self-image, media representations and the skincare community (14%). Other dermatological diseases or problems such as eczema or dry skin, hair loss or thinning, sun spots, wrinkles, excess fat, insect bites, moles, and herpes were less frequently searched for.

This search for medical information online means that patients are progressively acquiring an active role in healthcare and performing and independent assessment of their disease. Thus, the physician-patient relationship is becoming more symmetrical in regard to

medical knowledge. This knowledge parity does not have to be detrimental to the physician-patient relationship. In fact, it can be beneficial, but dermatologists need to be aware of the information that patients access in order to be able to offer the best possible care (George et al., 2012; Benabio et. al., 2013; Mueller et al., 2019). The abundance of medical information shared by patients on social media has shifted health communication from the traditional pattern, in which health authorities and physicians transmitted knowledge to patients, into an information transmission model in which many times laypeople are more influential than health professionals (Sun et al., 2021; Janda et al., 2020).

The broad and constantly growing search for dermatological information online has risen concerns about the quality of this information, which many studies have proven to be misleading or even harmful (Mueller et al., 2019; Gorrepati et al., 2021; Iglesias-Puzas et al., 2021; Chen et al., 2021). Although patients have stated that they look for information from health care professionals (Gantenbein et al., 2020), the reason behind the mediocre grade of the information they access is mainly that information generated by professionals is scarce. Most content is produced by individuals without any dermatological training (Zheng, Ning et al., 2021; Nikookam et al., 2020; Ranpariya et al., 2018) It is important to keep in mind that patients have affirmed they wish that more high-quality, professional information was available in social media. However, studies suggest that, many times, they are not able to distinguish good quality and bad quality information (Schoenberg et al., 2020).

Apart from using social media platforms to search for medical information, patients also use these sites for other purposes, such as to find physician referral services or support groups (Udey et al., 2020; Gorrepati et at., 2021; Iglesias-Puzas et al., 2021; Orgaz-Molina et al., 2015).

Social media has also proven to be an interesting resource for dermatologists. Dermatologists are among the group of physicians who are increasingly becoming active on social media. Some are even recognized as social media influencers, that is to say, users with a high number of followers. These influencers reach a large audience and can affect patients' health-related decisions and attitudes (Ranpariya et al., 2018; Karimkhani et al., 2014; Guzman et al., 2020; Sierro et al., 2020). The majority of dermatologists that engage in social media are female, live in metropolitan areas, and work in private practice (Miller et al., 2018). The

majority of the content that they share is educational (50%) and it is mostly related to cosmetic dermatology (Miller et al., 2018; Ross et al., 2015).

Apart from providing the opportunity to counterpart misinformation and engage in health promotion (Sun et al., 2021), social media constitutes an asset for dermatologists for continuous medical education, medical research, marketing and social networking (Croley et al., 2019; Benabio et al., 2013; Freitag et al., 2017; Travers et al., 2012). All these opportunities have risen interest in social media amongst younger generations of dermatologists. In an online survey answered by dermatology residents in 2018, 59.6% believed social media is either very important or extremely important to the field of dermatology, and most of them considered it is mostly helpful for patient education (Wang et al., 2018). However, although social media use is becoming increasingly prevalent amongst dermatologists, it is still a controversial practice. The main concerns are patient confidentiality, and legal and ethical issues (Sierro et al., 2020; Guzman et al., 2020, Zhou et al., 2018).

In addition to dermatologists, the presence of dermatological journals and professional associations in social media is also growing, and these networks are proving to be a valuable resource to enhance journal readership and establish research collaborations. A cross-sectional study carried out in 2018 found that most professional organizations on social media used Facebook, followed by Twitter and LinkedIn (Patel et al., 2018).

In summary, although social media has immense potential to improve dermatological health promotion and patient education, and can also be very useful for dermatologists, many concerns prevail. As a consequence, it is essential to summarize the upsides and downsides of social media use in dermatology, to find answers to the challenges that it encompasses, and to highlight strategies that can strengthen the positive aspects and counterpart the negative ones.

1.3 Social media platforms in dermatology

Social media is a phenomenon that has revolutionized the communication of individuals throughout the world (Edosomwan et al., 2011). It refers to web-based tools and mobile technologies that allow people to connect and share information regardless of geographical and time barriers (Benabio et al., 2013). Since their launch on the early 2000s, the use of these platforms has grown exponentially. The most popular social networks nowadays are YouTube,

Instagram, TikTok, Facebook and Twitter (Tankovska, 2021). Each of them has differential features in the type and format of the information that can be shared through them (Taberner, 2016; DeBord et al., 2019).

1.3.1 YouTube

YouTube is an open access video-sharing platform. It is the second most accessed website worldwide, with more than two billion active monthly users (Gorrepati et al., 2021; Mueller et al., 2019). Dermatological content is vastly available on YouTube, and a descriptive analysis of videos covering dermatological topics yielded over 47 million views, which reflects the high demand for this content (Mueller et al., 2019; Travers et al., 2012). This means that YouTube holds massive potential for dermatologists to disseminate evidence-based information and contribute to patient wellbeing, so much that the World Health Organization has explicitly recommended the use of this platform for this purpose (Boyers et al., 2014). In fact, one of the most popular categories of dermatological videos are "How-to" videos, which shows patients how to take care of healthy skin or of their dermatological disease. Taking into account that YouTube's influence on health-related decision-making has already been demonstrated, this type of educational video could greatly improve patients' skin problems and therefore their quality of life (Boyers et al., 2014; Travers et al., 2012).

Although some studies (Miller et al., 2018) have found that dermatological content on YouTube consists almost entirely of educational content, others have demonstrated that there is a wide presence of videos that disseminate unscientific, misleading and even harmful information (Gantenbein et al,, 2020; Mueller et al., 2019; Lenczowski et al., 2018). One of the major deficiencies found in these videos is absence of referral to sources of information (Galadari et al., 2018; Mueller et al., 2019). Many studies have concluded that this abundance of low-quality information is a consequence of the scarce presence of dermatologists, academic journals and health organizations on YouTube (Mueller et al., 2020; Pithadia et al., 2020; Freemyer et al., 2018). Therefore, several strategies have been suggested to increase the presence of evidence-based dermatological content on YouTube, and to increase its visibility, such as cooperation between dermatologist associations and search engine providers (Fogel et al., 2016; Lenczowski et al., 2018). Another strategy that has already been carried out by the American Academy of Dermatology is that international dermatology associations provide

funding for video production; they funded an educational video on the treatment of acne with isotretinoin (Boyers et al., 2014).

Another important thing to keep in mind is that a negative correlation has been found between video quality and the number of likes it receives: Low-quality videos are more highly-rated, which means it is also important to increase the attractiveness of high-quality videos so that they become more visible (Boyers et al., 2014).

1.3.2 Instagram

Instagram is a free mobile photo and video-sharing service that has over 1 billion active users every month, mainly young people, with over 90% of them under the age of 35 (Wong et al.,2019; Fogel et al., 2016; Wang et al., 2017; Zhou et al., 2018). Therefore, it could provide a useful means to educate this segment of the population (Zhou et al., 2018). On this network, "hashtags" are used to indicate the subject of the post, and to link it to other posts of the same subject (Karimkhani et al., 2014; Alex et al., 2020). Similar to what happens on YouTube, studies have demonstrated that dermatologists only produce a very small proportion of the dermatological posts on Instagram, whereas the majority of content is produced by individuals without any dermatological training (Wells et al., 2020; Park et al., 2018).

As well as for educating patients, it is a useful tool for dermatologists to share challenging cases with colleagues over the world, contributing to better patient care and to continuous medical education (Oltulu et al., 2018). It can also help dermatologist in building a brand image and increasing patient referrals (Wong et al., 2019).

As for the type of dermatological content shared on Instagram, studies have obtained different results: While a cross-sectional study analyzing content related to skin on color in 2020 found that the more than half of the posts were advertisements (Wells et al., 2020), a broader study on dermatological content on Instagram from the same year (Sierro et al., 2020) demonstrated that half of the posts were educational, a third were personal posts, and the remaining were accomplishment and advertisement posts. This controversy could be explained in part by the different criteria used to define the categories.

1.3.3 TikTok

TikTok was founded in 2016, and it has been defined as the world's fastest growing social media platform (Nikookam et al., 2021; Zheng, Ning et al., 2021). It allows users to share short, catchy videos. It is used by a younger segment of the population, comprised mainly of adolescents. As a consequence, the most widespread dermatological content on this platform is related to acne (Chen et al., 2021). This grants dermatologists with a great opportunity to educate young patients on acne, a topic in which the prevalence of misinformation on the Internet is vast. Unlike other social media platforms, in which content is mainly shared with followers, TikTok's algorithm suggests videos on similar topics to the ones users have recently watched. This algorithm makes it easier for dermatologist's videos to spread among skincare videos (Presley et al., 2021). Another useful feature for dermatological education that TikTok offers in the duet function: It allows dermatologists to respond to other users' videos with their own, which can be an effective tool to dispel misinformation (Sierro et al., 2021).

1.3.4 Facebook

Facebook is a social media platform founded in 2004 that still remains the biggest social network worldwide, with 2.89 billion monthly active users in the second quarter of 2021 (Tankovska, 2021). It allows users to share pictures, videos, life events or accomplishments, and text. Facebook profiles require reciprocity, which means a user has to accept other users as Facebook friends so that they are able to see their posts (Taberner, 2016). Studies have concluded that personal Facebook profiles should not be used for professional purposes, and that physicians should not accept patients as Facebook friends (Payette et al., 2013). A Facebook page, also called business page or fan page, is a more appropriate medium for this purpose, because there is no connection between it and the user's personal profile, and because there is not limit in the number of followers or fans it can have (Payette et al., 2013).

Facebook also facilitates the creation of groups focused on common interests, which can be open or closed, and provide a useful platform for discussing professional issues or for continuing medical education, such as groups focused on dermoscopy or dermatopathology (Schoenberg et al., 2020).

Furthermore, Facebook is also a useful tool for creating patient groups, and therefore it facilitates peer support (Iglesias-Puzas et al., 2021).

1.3.5 Twitter

Twitter is a microblogging platform in which users share short messages, with a maximum length of 140 characters, known as tweets. Although the length is limited, tweets can include links and images (Benabio et al., 2013; Travers et al., 2012; Wang et al., 2017). An analysis of the dermatological content in this platform in 2020 found out that 53% of the posts had personal content, 43% had educational content and 3% were advertisement posts (Sierro et al., 2020). This platform is eagerly used by very high indexed dermatology journals, such as the British Journal of Dermatology and the Journal of the American Academy of Dermatology, and some authors have concluded that it can be a very powerful tool to enhance readership and create online journal groups (Amir et al., 2014; Blumenthal et al., 2019). In this way, it contributes to medical education, dissemination of research findings, and collaboration among physicians, making these processes faster, broader and more accessible than they were traditionally (Daneshjou et al., 2020; Wehner et al., 2014).

Twitter can also be used for patient education and health promotion, and it is increasingly being used to study attitudes of the population to preventable disease caused by behaviors such as tanning bed use, providing insight for health campaigns (Vasconcelos et al., 2020; Falzone et al., 2017; Stekelenburg et al., 2020; Sugawara et al., 2016). In this matter, a study carried out in 2019 found that sharing of sun protection information by celebrities and non-health related accounts with a high following could have a higher impact than health organizations and contribute to a greater spread of skin cancer prevention messages (Vasconcelos et al., 2020).

Twitter can also be a useful for patient organizations or peer-communities, providing support and education for patients (Sarker et al., 2017).

1.3.6 Less popular platforms

Reddit

Reddit is a social networking website with a forum-based interface, centered on building communities for individuals with similar interests than can share information. Its structure comprises multiple user-generated subreddits which act as forums that allow users to post ideas, questions, links, images and videos (Buntix-Krieg et al., 2017). Anyone with internet access can participate in these forums (Okon et al., 2020). In this way, Reddit allows geographically dispersed individuals to interact with individuals with similar interests (Buntix-Krieg et al., 2017, Chu et al., 2021). A study carried out in 2020 demonstrated that this network can be useful for dermatologic research and engagement with the public, especially for common dermatology topics such as acne, psoriasis and tanning (Okon et al., 2020).

Tumblr

Tumblr is a microblogging platform founded in 2007 that allows users to post multimedia and blogs. As of July 2021, it hosts more than 529 million blogs, but it remains a social media platform that lacks presence from dermatology journals and organizations (Correnti et al., 2014; Tankovska, 2021).

Pinterest

Pinterest is a social media platform with 478 million monthly active users in 2021, which focuses on sharing visual content. Users create and share individual bookmarks called “pins” and group them into larger collections called “boards”, that include pins related to the same subject (Tankovska, 2021; Whitsitt et al., 2015).

A cross-sectional study carried out in 2015 that analyzed the dermatological content on this platform found that informative pins and boards were the most common, comprising approximately half of the content, which the authors concluded that could represent a desire by users to access quick, easy to read information, or short summaries. They also found that only 24% of dermatology-related boards were created by healthcare professionals, and that dermatology journals had little presence, with only one board posted by JAMA Dermatology (Whitsitt et al., 2015).

Snapchat

Snapchat is a social media platform launched in 2011 in which users share videos and photos that only last for 24 hours (Patel et al., 2017). Most dermatology journals, professional organizations and patient advocate groups are not present on Snapchat, probably because the brevity of the "snaps" renders it less useful that other platforms to spread dermatology-related information. However, although it might not be a useful tool to educate patients, it can be used by dermatologists as a marketing tool to reach millennials, which is the segment of the population that is most present on this network (Patel et al., 2017).

LinkedIn

LinkedIn is a social media platform launched in 2003 that did not become popular until some years later. It allows users to set up a professional profile, including information on work experience and education, to find job offers and to establish a network of professional contacts. It can provide professional opportunities to dermatologists, but it is not a useful network for patient education or health promotion (Taberner, 2016).

WeChat

WeChat is the most popular social media application in China, with more than 1 billion monthly active users in 2020. It has evolved into a comprehensive platform that provides services such as Intelligent Healthcare, which allows users to find healthcare professionals, arrange consultations and pay medical bills (Tan et al., 2020).

Google+

Google+ was a social media platform launched in 2011 that disappeared in April 2019. Compared to other social networks, its main advantage was that it granted tools for search engine optimization, which meant that users could potentially reach a bigger audience. However, it was not broadly used by dermatology journals or associations, with JAMA Dermatology being the only active journal in 2017 (Hill et al., 2018).

Flickr

Flickr is a photo-sharing social media platform launched in 2004. At the start, it quickly become very popular, but then it progressively lost many of its users until 2020. A study performed in 2018 that analyzed dermatological content on this network found that none of the top dermatology journals had a Flickr account, and that the only professional association present

on this network was the European Academy of Dermatology and Venereology, and that it had not been active in a year (Kuschel et al., 2018).

Doximity

Doximity is a social networking platform for United States healthcare professionals and medical students. Regarding its dermatological content, a study carried out in 2016 found that the majority consisted of informative articles, which were concise and covered general topics that are applicable to a large audience, like “sunscreen recommendations” and “advice from dermatologists”. This type of content was also the most shared to other social media platforms. Research articles were the second most common type of content, and they were less frequently shared (Ashack et al., 2016).

2. Research question and objectives

This thesis departs from the assumption that social media platforms offer numerous opportunities for dermatologists, and that research from primary sources is necessary to find strategies to maximize these opportunities and to counterpart the drawbacks of these networks.

Mounting research has shown that social media platforms offer an unpaired resource for health promotion, for collaboration between dermatologists, and for education and research (Mueller et al., 2019; Boyers et al., 2014; Oltulu et al., 2018: Daneshjou et al., 2020; Wehner et al., 2014). At the same time, multiple studies have warned about the potential ethical challenges and setbacks related to the use of these networks (Ranpariya et al., 2020; Gantenbein et al., 2020; Zhou et al., 2018; Park et al., 2018).

Most of these contributions only describe some of the potential benefits or drawbacks of social media use, which makes it difficult to have a detailed overview and design optimal strategies for social media use by dermatologists. Additionally, most of the studies performed rely on conceptual developments and secondary sources. This is in contrast to the tradition of dermatologic research, which relies mostly on primary sources (i.e., everyday practice). Consequently, real-life data of dermatologist participation in social media platforms is very scarce.

This background raises the following questions: What are all the advantages of social media use by dermatologists? Can it provide more benefits than the most well-known ones? What are all the drawbacks of these platforms? What strategies have been identified to bypass them? Can we design practical strategies that harness their advantages and counteract their drawbacks? How does a real-life dermatologist profile on social media perform, and how can we optimize this performance and successfully have a positive impact on patient wellbeing and quality of life? Gaining deeper insights on all these matters is critical for developing a successful approach for dermatological presence on social media.

Answering such a multifaceted research question requires a profound understanding of different issues identified in the literature. Therefore, as an initial theoretical approximation to the problem, the first part of this thesis focuses on performing a thorough, systematic review

of the literature that assembles the benefits, drawbacks and challenges that social media platforms present for dermatologists, whose accurate and detailed characterization comprise the first, second and third objectives of this thesis. The remaining objectives are based on the results of this systematic review of the literature and the research gaps identified in it, and they have a more practical purpose. The thesis investigates the most advantageous strategies to have a positive impact on dermatological health promotion through the large-scale, real-life presence of a dermatologist on social media.

Many studies have found that the potential of social media platforms for health promotion has not been fully realised due to the limited presence of dermatologists on these networks (Nickles et al., 2022; Killion et al., 2022). This may be partly attributable to the insufficient knowledge of how to develop a successful presence on social media. Consequently, further research from primary sources is necessary to increase dermatologists' knowledge of this field. The fourth and fifth objectives of this thesis focus on two key aspects for successful health promotion: 1) Identification of the dermatological topics that the audience finds most interesting and that therefore gain more visibility on social media, and 2) Determination of factors that influence audience retention on a dermatologist-led channels, to provide insights that can help dermatologists create engaging content that becomes successful.

An added problem to the limited presence of dermatologists on social media is that the scarce successful presence of dermatologists on these platforms has been criticized for focusing on cosmetic dermatology and not representing the role of dermatologists accurately (Guzman et al., 2022; Sun et al., 2021). In this context, a research question that has not been systematically addressed is the following: Is it feasible for a dermatologist to develop a relevant presence on social media while representing all dermatological topics equally? Consequently, this research is designed to explore from the inside how the public reacts to the presentation of different dermatological topics by a dermatologist. More specifically, the aim of this research is to determine which dermatological topics interest social media users most. This analysis will allow us to deduce whether it is feasible for a dermatologist to become influential on social media while presenting all dermatological topics with equal prominence, as has been suggested from a conceptual perspective.

As well as the adequate selection of the topics presented, other factors can have a very important repercussion on the audience retention of dermatological videos shared on social

media. Audience retention matters for two reasons. First, it is a necessary condition to ensure viewers' proper understanding of the video content and, therefore, to achieve positive behavioural changes (Guo et al., 2014). Second, social media algorithms take audience retention into consideration to rank each video (Vhatkar et al., 2020). The smaller the audience retention of a video, the lower the video ranking, which implies that the video is not presented to potential viewers and thus cannot have the intended impact. In fact, on YouTube, the top 3% of videos get 85% of all views (Gupta et al., 2020).

In summary, the research question and the five main objectives of this thesis are the following (see Section 4.2 for the hypotheses and objectives addressed in each publication):

Research Question (RQ): How can dermatologists develop a social media presence that optimizes the benefits of these platforms while minimizing their drawbacks, and have a meaningful impact on dermatological health promotion?

Objective 1: Bring together and discuss the advantages that social media provides dermatologists.

Objective 2: Assemble and discuss the drawbacks of using social media platforms and identify possible solutions to bypass them.

Objective 3: Highlight the challenges that the presence of a dermatologist on these networks encompasses, and identify practical strategies that harness the advantages and counteract the drawbacks.

Objective 4: Systematically analyse which dermatological topics interest the public most, and to find out whether it is feasible for a dermatologist to become influential on social media while presenting all dermatological topics equally.

Objective 5: Determine which factors influence audience retention on a dermatologist-led social media channel and provide insights that can help dermatologists create engaging content that becomes successful.

The thesis is structured as follows. Within Part I, section 3 lays out the theoretical framework. Section 4 provides an overview of the studies conducted and formulates the propositions and hypotheses addressed in the publications. Section 5 describes the methods utilized. Section 6 presents the main results, and Section 7 discusses their theoretical contribution, practical implications and limitations, as well as further research avenues. The full text of the published and accepted manuscripts can be found in Part II. In this part, a list of publications and quality

indicators is presented. The conclusions comprise Part III of the thesis. The references are included in Part IV.

To make this lengthy manuscript easier to follow, Figure 1 depicts the key concepts and relationships underpinning the composition of the dissertation. The top part shows that the research question can be addressed from various perspectives, depending on the departing field of study. Regarding the selected approach, this thesis sits at the intersection between health promotion, the presence of misinformation on social media, and medical ethics. The middle part of Figure 1 illustrates that the research question has been formulated amidst some theoretical tensions that have been addressed in the previous literature: the incomplete conceptualization of the benefits, drawbacks and challenges of social media use (see related publication in Part II, Section 1), the need for influential dermatological presence to dispel misinformation (see related publication in Part II, Section 2), and the challenge of creating a successful dermatological presence on social media while complying with all aspects related to medical ethics (see related publication in Part II, Section 3). The bottom part of Figure 1 summarizes this thesis' empirical work on the development of a dermatologist-led, real-life, large-scale social media presence, and the analysis of the data obtained through it.

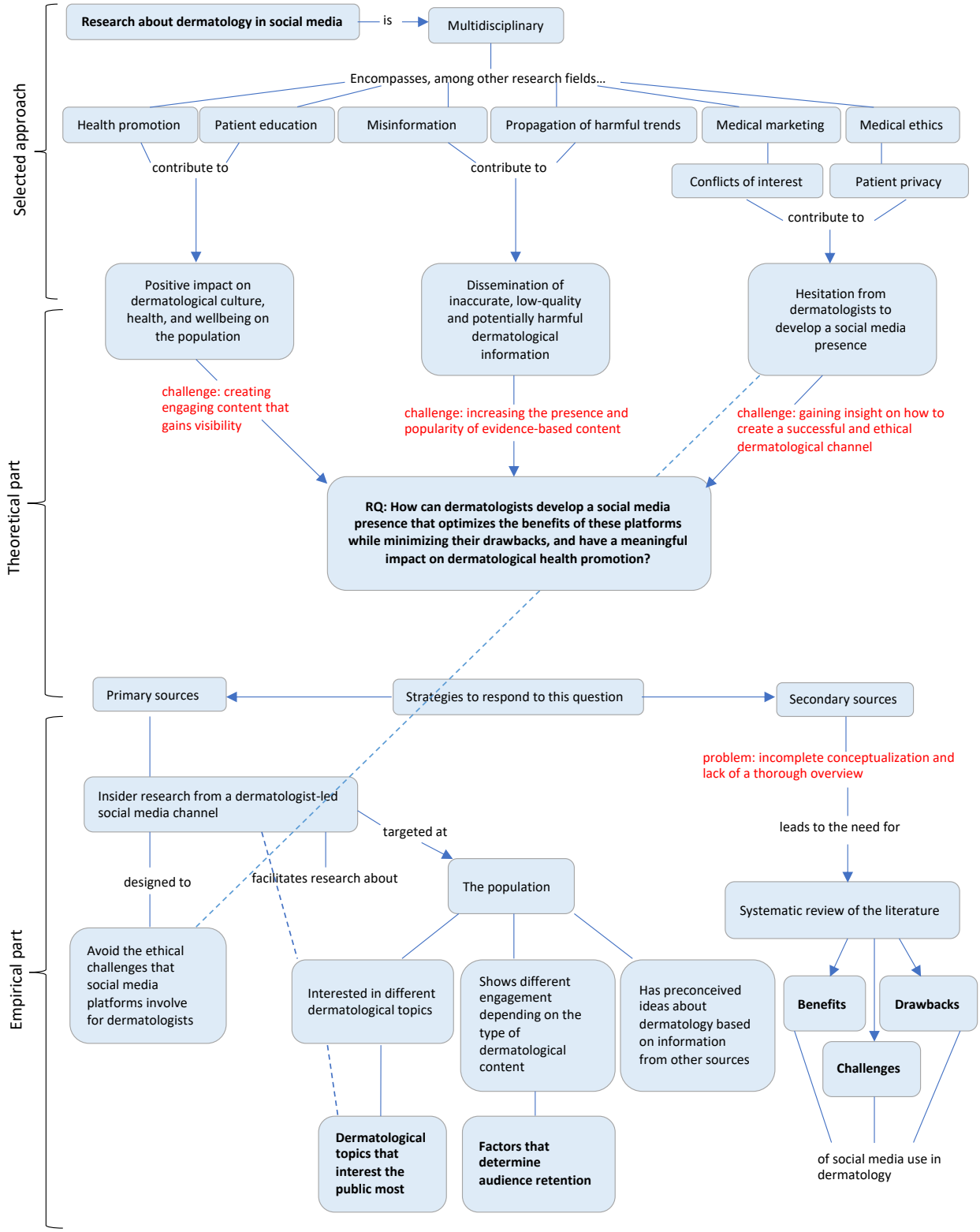


Figure 1. Conceptual diagram of the thesis.

3. Theoretical framework

3.1 Social media influencers

Social media influencers are non-traditional celebrities who have become famous through social media (Djafarova and Rushworth, 2017). While traditional celebrities include musicians, movie stars, or TV personalities, social influencers use social media channels for blogging about their lives or about specific subjects, building a large fan base, and, thus, attaining celebrity status and becoming influential (Khamis et al., 2017).

Social media influencers are opinion leaders on social media platforms. They present themselves as "ordinary" people online and appear approachable, authentic, and friendly. From a marketing perspective, it has been observed that consumers are generally positively influenced by online advertisements featuring endorsers with whom they can identify (Basil, 1996). Thus, research shows that identification with endorsers is strongly linked to buying behaviour, because consumers' perceived risk is significantly reduced when they make a purchase based on their admiration of and trust in social media influencers.

Social influencers strive to build a specific public identity focused on a target audience. Central to their self-branding strategy is constructing an authentic personal brand centered on a sense of genuineness and intimacy (Khamis et al., 2017). Research shows that individuals see influencers as accessible, and possessing a familiar personality (Benito et al., 2020). In that aspect, social influencers differ from more traditional celebrities, because they take the time to get to know their fans and interact with them. In doing so, they attract large numbers of followers and, as a result, they become influential.

From a dermatological health promotion perspective, this influence has great potential to divulgate evidence-based skin care and to counteract misinformation. In the same way that the genuineness and accessibility transmitted by social media influencers creates conviction and buying behaviour, dermatologist social media influencers can potentially create science-based skincare culture more effectively than traditional media.

3.2 Dermatologists as social media influencers

Although the presence of dermatologists on social media is still scarce, some dermatologists have successfully attained a significant number of followers and have become social media influencers, with the potential to affect patients' health-related decisions and attitudes.

Dr. Sandra Lee, a board-certified dermatologist based in California, has become a global social media phenomenon, with over seven million subscribers on YouTube and over four million followers on Instagram.

To have a chance of becoming influential, dermatologists should create educational content that is also engaging. Some studies have been performed to determine what type of content is perceived as more attractive by users. In 2019, Morrison et al. aimed to find out what type of skin cancer prevention video was most engaging, so they posted three different types of videos on Facebook: a parody video made by a physician influencer who shares humorous content, a video created by an Instagram celebrity and a fact-based video featuring statistics. The results showed that the parody video had the highest engagement, while the fact-based video had the lowest engagement. In 2020, Klietz et al. classified Instagram posts from a medical account with 10,500 followers into four categories: aesthetics, private life, disease and science. Private life posts received the greatest engagement, which could indicate that telling the story of the owner of the accounts is relevant and that users seem to like doctors to whom they can personally relate. Science posts failed to attract people.

Dermatologists need to deliver engaging content without compromising scientific accuracy. Evidence suggests that to increase interest in accurate dermatological content and dispel misinformation, it is necessary to adopt methods of communication that thrive on social media, such as making 'stories' and videos, using 'hashtags,' and creating interactive content (Benabio et al., 2013; Ranpariya et al., 2020; Muller et al., 2019). It is also important to publish content on common dermatological conditions that trouble a broad audience, such as acne or pigmentation disorders (Buntinx-Krieg et al., 2017; Long et al., 2022).

3.3 The theory of persuasion and its utility in health promotion

Persuasion is a process addressed at influencing people's attitudes and/or behaviour. Persuasion may be used to modify people's attitude towards skin care, sun protection, or tanning booths, and their behavioural intentions and actual behaviour.

Dual-process theories are popular approaches to explain persuasion. They explain how individuals react to a piece of information. The elaboration likelihood model (ELM) and the heuristic-systematic model (HSM) are two of the most popular dual-process theories (Chaiken, 1980; Petty et al., 1986).

Both the ELM and HSM explain the mechanisms of information processing similarly. Overall, both models propose that people use information cues, in two forms, heuristic (peripheral) cues and systematic (central) cues, to assess a message (Petty and Cacioppo, 1986; Chaiken an d Maheswaran, 1994). People who are not motivated to process the information (and/or do not have the ability to process it) use the heuristic or peripheral information cues to help them understand the perceived information. In other words, information cues such as the graphic quality and the degree and appearance of the spokesperson influence a person's judgment of the message (Petty and Cacioppo, 1986). This is the so-called peripheral route of information processing.

Differently, people who are motivated to process the information (and/or have the ability to process it) are more likely to consider the systematic or central cues, such as the strength of the argument and the evidences provided by the spokesperson, to evaluate the message (Petty et al., 1981). This is the so-called central route of information processing.

The peripheral route involves less cognitive effort and more heuristic-based persuasion. Under the peripheral route individuals focus on superficial signals to generate attitudes and make quick decisions (Cialdini, 2009). The central route is linked to the usefulness, quality, importance and trustworthiness of the information and its source (Ki and Kim, 2019). When new attitudes stem for the central route, they are likely to be more enduring than the ones formed from the peripheral route (Petty and Cacioppo, 1986).

Despite the similarity between the ELM and HSM, the two theories are different in their ways to define how individuals choose and use the two processing routes. Petty and Cacioppo (1986) proposed that the use of a peripheral or central route of information processing is mutually exclusive. That is, a person uses one route to process the information. Chaiken (1980) provided an alternative explanation, by arguing that heuristic information processing can co-occur with systematic information processing.

According to Chaiken and Maheswaran (1994), three effects, attenuation, additivity, and bias, influence the co-occurrence of two processing modes. The attenuation effect of the HSM consists on how the systematic mode of information processing attenuates the influence of the heuristic mode of information processing. In other words, an increased level of systematic processing mitigates or weakens the effects of heuristic processing on one's judgment of the message. The additivity effect emphasizes the independent impact of systematic processing and heuristic processing on individuals' judgment of a message when two modes are coexisting. Finally, the bias effect addresses the significance of how heuristic processing may influence systematic information processing through biased judgment (Petty et al., 1981). Biases may be positive or negative. As an example of a bias, people could consider that popular, non-expert, lifestyle influencers could be a valid skin care information source.

Various studies have built on dual-process models to analyse the factors that explain the impact of influencers' messages on attitude change and behavioural intentions. Masuda et al. (2022) found that trustworthiness, perceived expertise and parasocial relationship or homophily (i.e., perceiving the spokesperson as a possible friend in real life) affect people's behavioural intentions (see Hugh et al. 2022, for similar conclusions). Casaló et al (2020) found that opinion leadership of the spokesperson is key to explain behavioural intentions of individuals. Opinion leadership was, in turn, driven by originality, uniqueness, and message quantity and quality (see also, Breves et al. 2019, and Ki and Kim, 2019, for similar findings). Xiao et al. (2018) found that both peripheral cues (expertise, trust, likeability, homophily, interactivity, and social advocacy) and central cues (argument quality, involvement, knowledge) affect information credibility, which in turn affect attitude towards the spokesperson's messages. Trivedi and Sama (2020) compared the effect of expert and attractive celebrity influencers on attitude change and found that the former have a larger effect on attitude.

All these studies are indicative that dermatologists (as experts and opinion leaders) have greater potential to influence skin care attitude and habits than non-expert influencers, when being able to develop scientifically based messages, but also attractive, understandable, people-oriented, and consistent.

4. Overview of the studies

This thesis comprises three research articles that have been accepted for publication in Journal Citation Reports (JCR) indexed journals. These publications are closely related and address the thesis' research question from different angles. Table 1 provides an overview of the objectives addressed in each publication and their corresponding propositions and hypotheses.

4.1 First study: "Benefits, drawbacks, and challenges of social media use in dermatology: a systematic review"

Due to the exponential growth of dermatological information on social media, the recent literature about this topic is abundant. While many authors have highlighted that social media constitutes a unique opportunity for patient education, other authors have focused on the potential risks that these networks involve.

The first three objectives of this thesis were to "bring together and discuss the advantages that social media provides dermatologists", "assemble and discuss the drawbacks of using social media platforms and identify possible solutions to bypass them" and "highlight the challenges that the presence of a dermatologist on these networks encompasses, and identify practical strategies that harness the advantages and counteract the drawbacks". While the remaining objectives are addressed empirically, the first three objectives serve as a holistic approximation to the topic in a theoretical way.

To address those objectives, a comprehensive systematic review was performed, dating from inception to July 2021. Finally, 161 articles were included. Fifteen benefits, eleven drawbacks and ten challenges of social media use in dermatology were identified and discussed. Suggested strategies to address the identified drawbacks were provided.

The benefits identified included dissemination of accurate information to counteract misinformation, providing top-quality service and improving marketing performance, being in control of your online reputation, understanding patients better, health promotion and the hight reach and low cost of awareness-building campaigns, improving patient quality of life, public health surveillance, source of new research gaps, drug adverse effect surveillance, hospital and residency program selection for residents, education and networking for dermatologists and dermatology residents, education for medical students, expanded access to dermatologists and better dermatological care, patient advocacy and increased impact factor and reach of journals.

The drawbacks identified consisted of potential risks to patient privacy and confidentiality, a negative impact on the patient–physician relationship, being hard to fit into a dermatologist's schedule, risk of self-diagnosis attempts by patients, the presence of misinformation and the difficulties of patients to discern good information from bad information, the propagation of harmful trends, access to medication without a prescription, the risk of distraction during working hours for dermatologists, lowered patient self-esteem, age and socioeconomic barriers and misconceptions about dermatologists.

The challenges analysed were the need for dermatologists, the need to adapt, the management of conflicts of interest, creating engaging content, keeping content professional and ethical, engaging with patients while not providing individual consultations, fitting social media into a busy schedule, educating patients on distinguishing high-quality from low-quality content, translating health promotion on social media into long-lasting behavioral changes and linking physician education and learning strategies on social media with positive patient outcomes. For all these challenges, possible solutions and strategies were provided based on the revised literature, and experiments were designed in the studies related to the empirical part of the thesis (see Section 4.2 and Section 4.3) with the aim of providing responses from primary sources.

The results of this first study suggested that, while some authors have argued that there are serious risks to using social media, several studies have indicated that the benefits are numerous and that risks are scarce when applying the same ethical standards as in traditional settings. Therefore, it concluded that dermatologists should not fear social media but rather feel a responsibility to educate patients by using high scientific standards and acting as leaders in the online world of skin health. It suggested that dermatologists should focus on improving

aspects found to be lacking by different studies, such as providing references to the sources of information used. At the same time, they should also aim to create engaging content to ensure visibility.

It was observed that the responsible use of social media by physicians can also have multiple other benefits, such as understanding patients better, generating new scientific findings, sharing difficult cases among professionals across the world and comparing approaches and protocols globally, leading to greatly improved patient care.

This study also detected that further research should focus on gaining additional insight into the profiles and characteristics of patients who perform online searches, such as which topics they are most interested in, or what factors determine their attention to specific types of content, therefore being major drivers of audience retention and successful health promotion. These insights served as the basis for the design of the empirical part of the thesis.

4.2 Second study: "What do Patients Want to See on Social Media? Evidence From a Two-Year Experiment"

As the first study revealed that further research should concentrate on learning about the preferences of patients who perform online searches, the fourth objective of the thesis was to "systematically analyze which dermatological topics interest the public most, and to find out whether it is feasible for a dermatologist to become influential on social media while presenting all dermatological topics equally". The first step to address this objective was to design and develop an experimental dermatologist-led social media presence.

In October 2019, the author of this thesis launched an educational dermatological YouTube channel. The channel was designed to avoid the risks and ethical challenges that social media involves for dermatologists. It does not include sponsored or personal content. Videos follow the DISCERN quality criteria (Zheng, Ning et al., 2021). References to relevant scientific literature are provided. Individual consultations are not answered; viewers are encouraged to consult a dermatologist. While commercial products are shown, because subscribers demand them intensely, product assessment relies on effectiveness. No commercial agreements are established.

A new video is launched weekly. After a two-year period, the channel had over 134,000 subscribers and 5.5 million views. 101 videos had been posted about a wide variety of dermatological topics. Specifically, the topics covered were the next: Acne and acne scars, rosacea, melasma, hidradenitis suppurativa, psoriasis, vitiligo, hair loss, atopic dermatitis, seborrheic dermatitis, nevi, sun protection, melanoma, basal cell carcinoma, squamous cell carcinoma, polymorphous light eruption, hyperhidrosis, folliculitis, laser hair removal, keratosis pilaris, postinflammatory hyperpigmentation, dermatological treatments such as benzoyl peroxide and isotretinoin, skin type, medical peelings, botulinum toxin, and active ingredients in cosmetics.

The second step to address this objective was to classify dermatological topics to study which are the ones that the public finds most interesting. As the limited successful presence of dermatologists on social media has been criticized for focusing on cosmetic dermatology and not representing the role of dermatologists accurately, the experiment was designed to find out whether there was a difference in the visibility of topics related to cosmetic dermatology and topics related to the medical fields of dermatology.

For that purpose, the 101 videos published in a two-year period were divided into cosmetic (51 videos) and medical dermatology (50 videos). Student's t-test was conducted to determine whether there were significant differences in views. Medical dermatology videos were then classified into three categories: Acne, facial dermatoses (excluding acne) and other dermatological diseases. This subcategorization was performed because it was apparent that there was a great variance in views within this category. A Kruskal-Wallis test was used to compare these three categories and cosmetic dermatology.

When comparing cosmetic and medical dermatology, no significant differences were found. When comparing the four categories, cosmetic dermatology and acne were found to generate significantly more views that other dermatological diseases.

Therefore, this study concluded that the public seems to be particularly interested in cosmetic dermatology and acne. This might make it challenging to become successful on social media while presenting a balanced portray of dermatology. However, focusing on popular topics can provide a real chance to be influential and protect vulnerable people from misinformation.

4.3 Third study: "Audience retention on educational dermatological videos: An exploratory study using a dermatologist-led experimental YouTube channel"

The goal of the third study of the thesis was also to contribute insights about the choices and predilections of the patients that perform online searches, a research gap found in the first study.

As well as focusing on topics that the audience finds interesting, in order to have an impact and successfully perform dermatological health promotion, dermatologists should create content that retains the public's attention.

This study focuses on audience retention on YouTube and its explanatory factors. To our knowledge, it is the first study in dermatology that focuses on audience retention on YouTube. Audience retention is essential for two reasons. First, it is a necessary condition to ensure viewers' proper understanding of the video content and, therefore, to achieve positive behavioural changes (Guo et al., 2014). Second, the YouTube algorithm takes audience retention into consideration to rank each video (Vhatkar et al., 2020). The smaller the audience retention of a video, the lower the video ranking, which implies that the video is not presented to potential viewers and thus cannot have the intended impact. In fact, on YouTube, the top 3% of videos get 85% of all views (Gupta et al., 2020).

YouTube defines audience retention as the percentage of the video watched on average by those who started watching the video. It divides each video into 100 time slots, representing 1% of the total length, and measures the audience retention of each slot as the ratio of the number of times that this portion of the video has been watched to the number of people who click on the video. The average retention rate is obtained as the mean. Multiplying this rate with the video length results in the average video watch time.

YouTube presents information on audience retention in the form of a graph (Figure 2a). The shape of this graph is hardly ever flat (i.e. viewers watch the video from start to finish). In contrast, viewers tend to abandon the video before finishing because of many reasons (e.g. the content or pace is not as expected or they consider that they have received the information they need before the end). Therefore, the graph tends to reflect a decline. This decline is almost never gradual. A typical audience retention graph presents a sharp drop at the beginning of the

video, a steady drop in the middle section and another sharp drop at the end. The rationale for this is as follows. At the beginning of the video, many viewers realise that the video is not what they expected, and they abandon it. Similarly, at the end of the video, viewers realise that the presenter is starting to say goodbye without providing additional valuable content, and they abandon the video.

Interestingly, the middle section of the video may show some spikes and dips (Figure 2b). Spikes appear when viewers focus on specific parts of the video. This can be in the form of selective watching (i.e. viewing these parts of the video and skipping others), re-watching or sharing this specific content with others. Dips occur when viewers skip some parts of the video. Spikes indicate that some parts of a video are particularly interesting for viewers and thus justify closer examination.

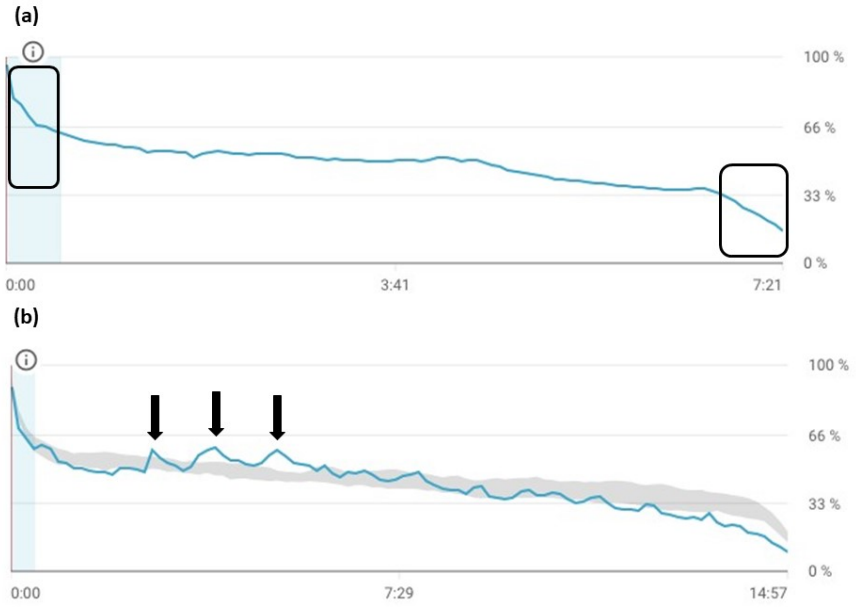


Figure 2. Audience retention graphs on YouTube. Typical YouTube audience retention graphs. The retention rate is presented on the y-axis, and the video timeline is presented on the x-axis. Sharp drops can be seen at the beginning and end of the video (within the rectangles). The middle section shows **(a)** a steady drop and **(b)** several spikes (arrows).

Data from the 137 videos published during the studied period (2 years and 9 months) was included, obtained from the YouTube analytics application programming interface (API). These data are not publicly available but provided by YouTube only to the video creator in the so-called YouTube Studio.

The spikes of all the videos included in the study were identified, and their content was analysed to determine what was particularly interesting for viewers. As the videos were educational, spikes were classified into conceptual or procedural knowledge.

The average audience retention was 41.69%. Video length and days from release had a negative effect on audience retention, with the effect of video length (β = -.6979; p = .0000) being strong and that of days from release being weak (β = -.023; p = .0000). Spikes were observed in 76 videos (55.47%), 68.15% of which were classified as procedural.

These data indicate that audience retention increases as video length decreases, and that viewers are essentially interested in practical information. Consequently, this study concluded that, to increase audience retention, dermatologists should design succinct videos and deliver procedural knowledge that creates value for the public.

The following table (Table 1) summarizes the research objectives and results of each publication.

Table 1. Publications, research objectives and summary of results.

Publication	**Research objectives**	**Summary of results**
Benefits, drawbacks, and challenges of social media use in dermatology: a systematic review (see Part II Section 1)	**Objective 1:** Bring together and discuss the advantages that social media provides dermatologists. **Objective 2:** Assemble and discuss the drawbacks of using social media platforms and identify possible solutions to bypass them. **Objective 3:** Highlight the challenges that a presence on social networks	The benefits identified included dissemination of accurate information to counteract misinformation, providing top-quality service and improving marketing performance, being in control of your online reputation, understanding patients better, health promotion and the hight reach and low cost of awareness-building campaigns, improving patient quality of life, public health surveillance, source of new research gaps, drug adverse effect surveillance, hospital and residency program selection for residents, education and networking for dermatologists and dermatology residents, education for medical students, expanded access to

	encompasses and identify practical strategies that harness the advantages and counteract the drawbacks. **Objective 4:** Acquire deeper knowledge of how dermatologists can become leaders in the dissemination of dermatological information online, thereby increasing the presence of evidence-based content and dispelling misinformation	dermatologists and better dermatological care, patient advocacy and increased impact factor and reach of journals. The drawbacks identified consisted of potential risks to patient privacy and confidentiality, a negative impact on the patient–physician relationship, being hard to fit into a dermatologist's schedule, risk of self-diagnosis attempts by patients, the presence of misinformation and the difficulties of patients to discern good information from bad information, the propagation of harmful trends, access to medication without a prescription, the risk of distraction during working hours for dermatologists, lowered patient self-esteem, age and socioeconomic barriers and misconceptions about dermatologists. The challenges analyzed were the need for dermatologists, the need to adapt, the management of conflicts of interest, creating engaging content, keeping content professional and ethical, engaging with patients while not providing individual consultations, fitting social media into a busy schedule, educating patients on distinguishing high-quality from low-quality content, translating health promotion on social media into long-lasting behavioral changes and linking physician education and learning strategies on social media with positive patient outcomes.
What do Patients Want to See on Social Media? Evidence From a Two-Year Experiment (see Part II Section 2)	**Objective 1:** Determine from the inside which dermatological topics interest social media users most. **Objective 2:** Analyze whether it is feasible for a	Videos on acne had the highest average daily views (268.66), followed by videos on cosmetic dermatology (255.49) and videos on other facial dermatoses (160.18). Videos on other dermatological diseases had the lowest average daily views (91.61). Student's t-test determined that there were no significant differences between views of cosmetic

	dermatologist to become influential on social media while presenting all dermatological topics with equal prominence, as has been suggested from a conceptual perspective.	dermatology and medical dermatology videos, even though cosmetic videos had more views on average (p = .1511). The Kruskal-Wallis rank test, which compared the three medical categories and cosmetic videos, showed that videos on acne and cosmetic dermatology received significantly more views than videos on other dermatological diseases (p =.0028 and p = .0005, respectively; see Table 2). There was a marginally significant difference (p=.0533) between views of videos on other facial dermatoses and videos on other dermatological diseases. No significant differences were found between cosmetic dermatology and acne (p=.2392), between cosmetic dermatology and other facial dermatoses (p=.5493), and between acne and other facial dermatoses (p=.1266).
Audience retention on educational dermatological videos: An exploratory study using a dermatologist-led experimental YouTube channel (see Part II Section 3)	**Objective 1:** Determine what factors influence audience retention on a dermatologist-led YouTube channel. **Objective 2:** Increase dermatologists' knowledge of how to develop a successful presence on social media.	The average audience retention of the 137 videos analysed was 41.69% (SD = 11.51), ranging from 23.03% to 147.69%. The audience retention was negatively and significantly associated with most video success indicators, such as views (r = -.2092; p = .0142), subscribers gained (r = -.2135; p = .0122), comments (r = -.1788; p = .0365), likes (r = -.2041; p = .0167) and shares (r = -.1771; p =.0384). Multiple linear regression was used to identify possible predictors of average audience retention. Only two predictors, video length and days from release, had a negative and significant effect on audience retention, with the effect of video length (β = -.6979; p = .0000) being strong and that of days from release being weak (β = -.023; p = .0000). Finally, a forward stepwise linear regression was used to identify possible predictors of average audience retention out of all candidate variables. Only length

	and days from release had a significant (and negative) effect on audience retention, which confirmed the findings of previous regressions. Spikes were observed in 76 videos (55.47%), and the total number of spikes was 157. The average number of spikes per video was 2.07, and the spike number ranged from 1 to 8. The video with the most spikes was a video about skincare for acne and rosacea. The mean upward change in the graph was 7.16%, and it ranged from 5% to 17%. The highest increase occurred in a video about sun protection for acne-prone skin. Among the 157 spikes encountered, 107 (68.15%) were classified as procedural, 33 (21.01%) as conceptual and 17 (10.83%) as transitional.

5. Methods

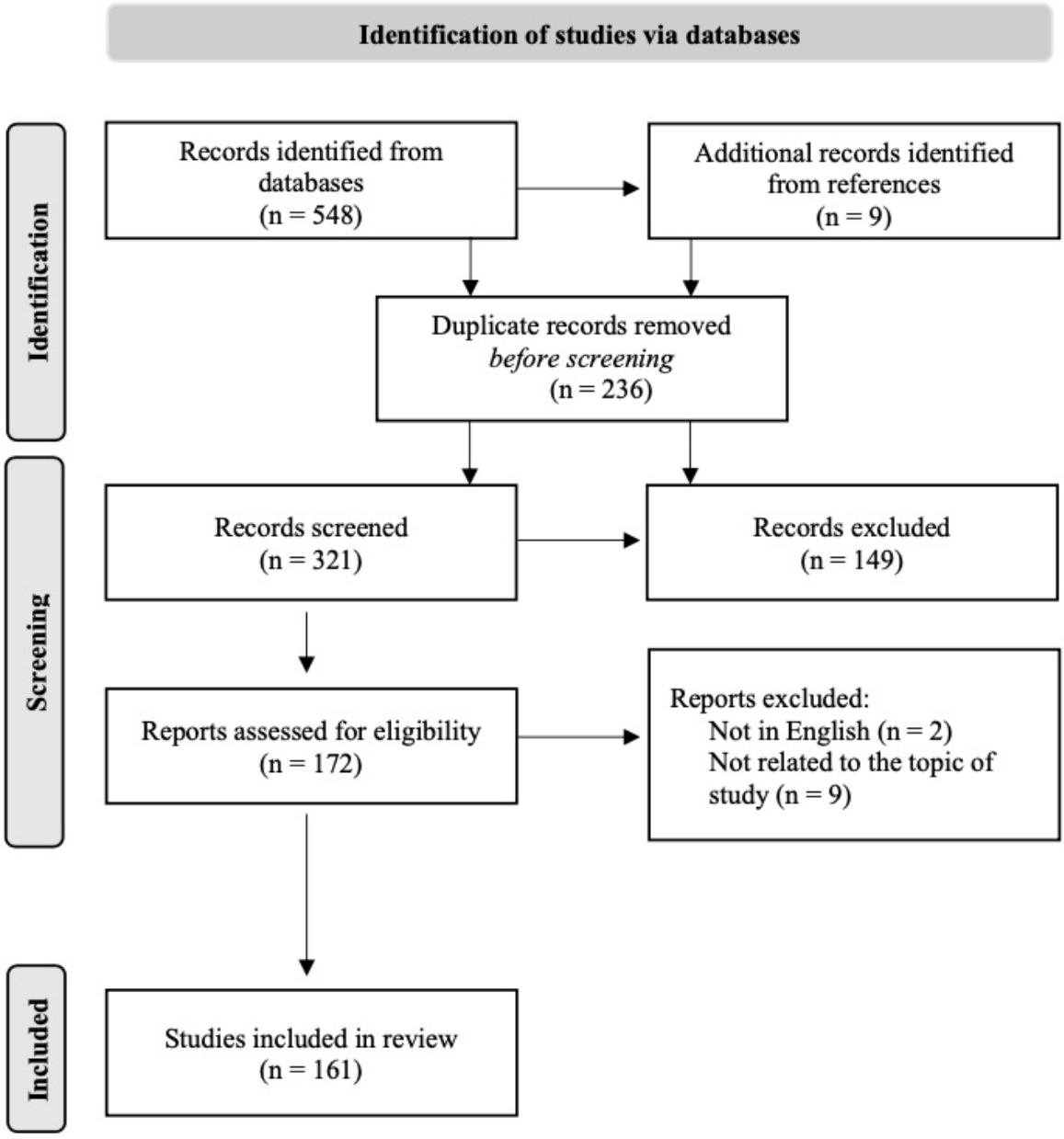
5.1 Systematic review of the literature

The first objective of this thesis, namely, "bring together and discuss the advantages that social media provides dermatologists", "assemble and discuss the drawbacks of using social media platforms and identify possible solutions to bypass them" and "highlight the challenges that the presence of a dermatologist on these networks encompasses, and identify practical strategies that harness the advantages and counteract the drawbacks" were addressed by a systematic review.

An article search was performed in July 2021 in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The following databases were searched: PubMed, Scopus, Cochrane Library and Embase. The following search terms were used: 'social media' (or 'social networks,' 'YouTube,' 'Instagram,' 'Twitter,' 'TikTok,' 'Facebook') and 'dermatology.' This search retrieved 548 results published from April 2009 to July 2021. The inclusion criteria selected (1) papers written in English, (2) case reports, original articles, reviews and letters, and (3) research in which the content of the article was related to the topic of study. After removing duplicates,

assessing the eligibility of the articles, and adding other studies found in the references, 161 articles were included in the review. The process is explained in Figure 3.

Figure 3. Systematic review flow diagram (according to the PRISMA 2020 guidelines).



After identifying and selecting the studies that met the inclusion criteria, a descriptive analysis of the selected studies was performed to determine the number of publications per journal and the number of publications per year.

Additionally, a content analysis of the reviewed articles was conducted according to the following structure: First, the different social media platforms used in dermatology were reviewed. Second, the benefits, drawbacks and challenges of social media use in dermatology were identified.

5.2 Design and development of a dermatologist-led social media presence

5.2.1 YouTube

The systematic review of the literature revealed that a considerable part of dermatological information on social media is not based on scientific evidence (Zheng, Ning et al., 2021; Chen et al., 2021; Reuter et al., 2021), and that dissemination of accurate information by dermatologists is essential to promote proper skin habits, dispel false and potentially harmful information and help patients make educated decisions (Benabio et al., 2013; Sierro et al., 2020; Long et al., 2022; Rafferty et al., 2021). It also highlighted that patients would like to find more content by dermatologists on YouTube. Moreover, it discovered that many authors (Roche et al., 2021; Ranpariya et al., 2020; Nickles et al., 2022; Reddy et al., 2021; Reynolds et al., 2019) have concluded that the first step in achieving the potential benefits of social media is to increase the volume of evidence-based content created by dermatologists.

In that context, and in order to be able to contribute to the existing literature by gaining insights from primary sources, the author of this thesis launched an educational dermatological YouTube channel in October 2019. The channel was designed to avoid the risks and ethical challenges that social media involves for dermatologists. It does not include sponsored or personal content. Videos follow the DISCERN quality criteria (Zheng, Ning et al., 2021). References to relevant scientific literature are provided. Individual consultations are not answered; viewers are encouraged to consult a dermatologist. While commercial products are shown, because subscribers demand them intensely, product assessment relies on effectiveness. No commercial agreements are established.

A new video has been launched weekly from 2019 to date. Videos cover a wide variety of dermatological topics. Specifically, the topics covered were the next: Acne and acne scars, rosacea, melasma, hidradenitis suppurativa, psoriasis, vitiligo, hair loss, atopic dermatitis,

seborrheic dermatitis, nevi, sun protection, melanoma, basal cell carcinoma, squamous cell carcinoma, polymorphous light eruption, hyperhidrosis, folliculitis, laser hair removal, keratosis pilaris, postinflammatory hyperpigmentation, dermatological treatments such as benzoyl peroxide and isotretinoin, skin type, medical peelings, botulinum toxin, and active ingredients in cosmetics.

After a period of 3 years and 5 months, more than 200 videos have been posted, and the channel has reached over 350,000 subscribers. The following figures show the evolution of the channel, regarding the number of views per year, the changes in the audience profile, analysed as the percentage of views according to age range and gender per year, the number of new subscribers per year, and engagement parameters, such as the number of likes and dislikes per year and the percentage of likes and dislikes on views.

Regarding the number of views per year (see Figure 4), they presented a 7-fold increase in 2021, a 1.5-fold increase in 2022, and an estimated 1.8-fold increase in 2023, reaching over 16 million views.

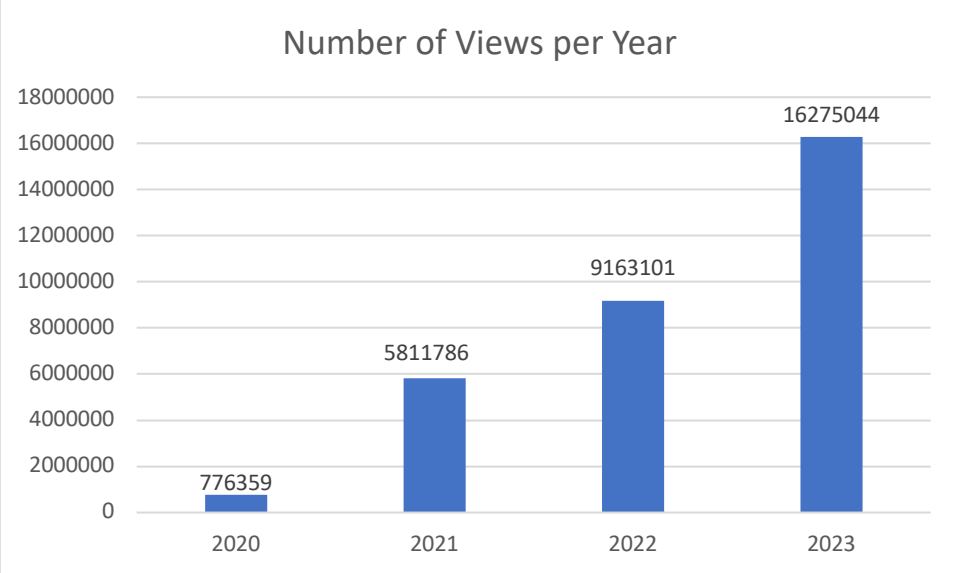
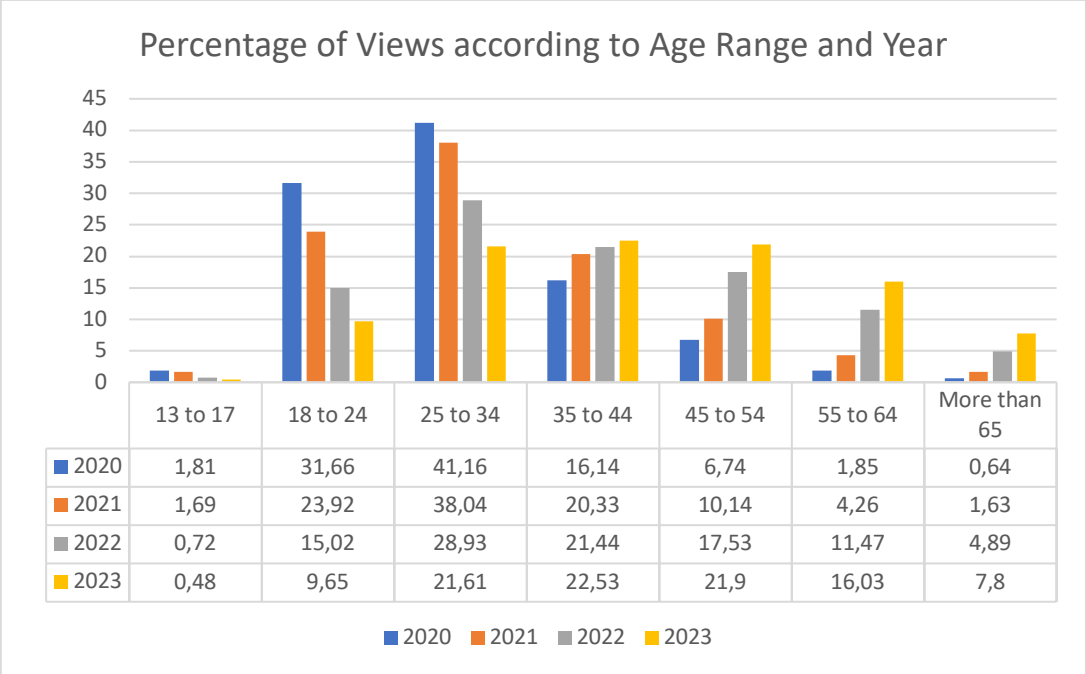


Figure 4. Number of views per year. Note: 2023 figures are a lineal estimation based on actual data up to March 27.

Views come from a wide age range, including a substantial number of views from 18 years-old to 64 years-old users. Interestingly, as views increased, the profile of the audience changed progressively. During 2020, most of the views corresponded to users aged 25-34, followed by users aged 18-24. In 2021, the main age groups remained the same, but the views

from users aged 35-45 and 45-54 increased substantially. During 2022, views still came mainly from users aged 25-34, but the second and third biggest groups was 35-44 and 45-54, growing over the group aged 18-24. Intriguingly, that trend from 2022 is continuing in 2023.



	13 to 17	18 to 24	25 to 34	35 to 44	45 to 54	55 to 64	More than 65
2020	1,81	31,66	41,16	16,14	6,74	1,85	0,64
2021	1,69	23,92	38,04	20,33	10,14	4,26	1,63
2022	0,72	15,02	28,93	21,44	17,53	11,47	4,89
2023	0,48	9,65	21,61	22,53	21,9	16,03	7,8

Figure 5. Percentage of views according to age range and year. Note: 2023 data refer to the period: January 1- March 27.

This shift in the age range of viewers might have the following explanation. As previously exposed (see Section 3.3), an important factor when subscribing to a YouTube channel is homophily, which is a term used to describe the feeling of identification with an influencer of the same age, gender and general features (Masuda et al., 2022; Hugh et al., 2022). As the author of this thesis belongs to the group aged 25-34, it seems logical that, based on this principle, from the beginning, most views have come from users withing that age range. However, as the YouTube channel grew and it was presented to more users by the YouTube algorithm, it seems that users belonging to more mature age groups subscribed to the channel due to other important factors when following a social media profile: perceiving an added informational value in the form of expertise, trustworthiness and argument quality (Masuda et al., 2022; Casaló et al., 2020; Croes et al., 2021).

Croes et al. (2021) found that younger users mainly follow social media influencers to find entertainment and companionship, while older viewers look for information sources. Thus,

it seems logical that older age ranges have proportionately grown more than younger age ranges in an educational channel.

As for the gender of viewers, women have comprised more than 80% of the audience since the launch of the channel, and the percentage has increased progressively. Even if the author of the channel is a woman, this finding does not seem to be a consequence of homophily or parasocial relationship. Contrarily, it seems to derive from the fact that most patients who perform online searches about dermatological topics are women, as observed in numerous studies (Gantenbein et al., 2020; Miller et al., 2018; Orgaz-Molina et al., 2015).

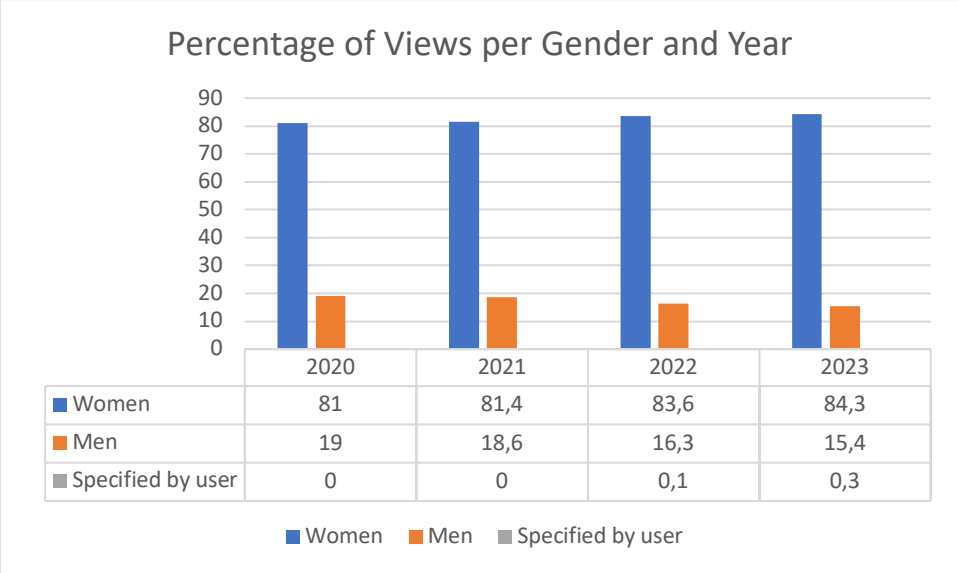


Figure 6. Percentage of views per gender and year. Note: 2023 data refer to the period: January 1- March 27.

As for the number of new subscribers per year, it experienced a 6-fold increase from 2020 to 2021, and an estimated 1.3-fold increase from 2022 to 2023.

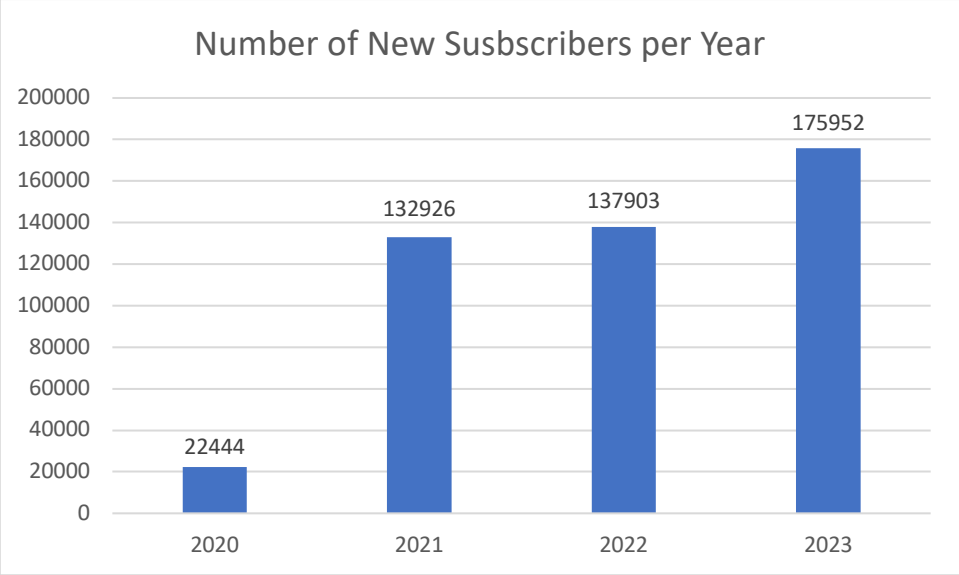


Figure 7. Number of new subscribers per year. Note: 2023 figures are a lineal estimation based on actual data up to March 27.

Regarding the likes and dislikes on videos, all of the videos had a like to dislike rate of over 95%, and most of them had a like to dislike rate of over 97%. The only video that had a like to dislike rate under 90% was a video about professional deep facial cleansing procedures. This video received a vast amount of negative comments from aestheticians because of its message about the importance of opting for procedures indicated and supervised by dermatologists. This experience showcases the presence of intrusiveness on social media and the repercussion it can have.

The video with most views and most likes was a video about how to improve skin texture, which transmitted an educational message about what pores are and how they cannot be closed, and about the different dermatologic conditions which can lead to enlarged pores, such as acne and photoaging. Specifically, it received over 1 million views and 26,669 likes.

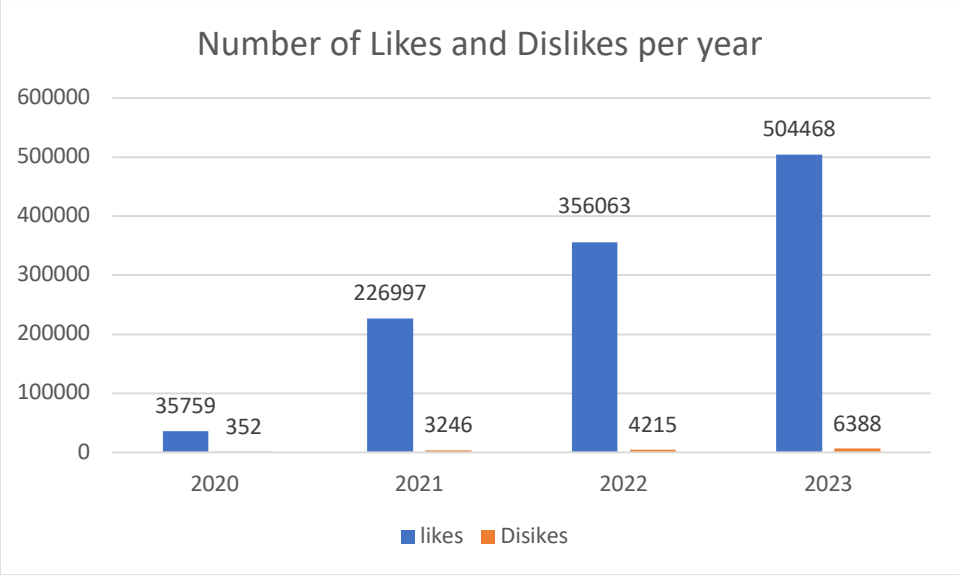


Figure 8. Number of likes and dislikes per year. Note: 2023 figures are a lineal estimation based on actual data up to March 27.

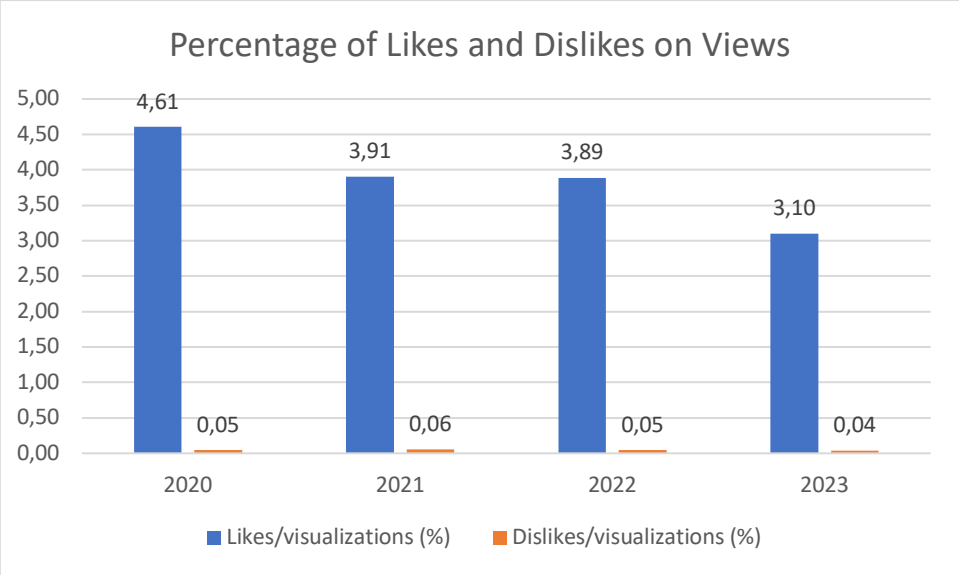


Figure 9. Percentage of likes and dislikes on views. Note: 2023 data refer to the period January 1-March 27. They are influenced by an outlier (i.e., a particularly successful video). The usually considered ratio, likes vs. dislikes (%), remains large and very similar for the whole four-year period: 99% (2020), 98,6% (2021), 98,8% (2022) and 98,8% (2023).

It is difficult to evaluate the degree of goodness of this channel evolution statistics, as the amount of information available about similar channels is scarce. Specifically, this type of information from educational, dermatologist-led channels is non-existent. Consequently, these analytics constitute a relevant contribution of this thesis.

Hence, to evaluate the degree of goodness of these channel analytics we used a study that considered 104,899 YouTube accounts and classified them as poor, average and good (www.marketingcharts.com , 2022). Metrics that scored at the 60th percentile or higher were considered to be good. Specifically, the study considered the following engagement analytics:

(1) Like to dislike rate (i.e., percentage of number of likes over the sum of likes and dislikes);

(2) Views to subscriber ratio (i.e., number of views over number of subscribers);

(3) Comments to view rate (i.e., percentage of users who have watched the video who commented the video); and

(4) Likes to view rate (i.e., percentage of users who have watched the video who explicitly stated that they liked the video).

When these metrics were applied to the channel, we observed that the channel was above the threshold level required to be considered good in all of them. Firstly, like to dislike rate was 98.6% (>97.4%). Secondly, views to subscriber ratio was 41.01 (>33.1). Thirdly, comments to view rate was .32% (>.04%). Lastly, like to view rate was 4.03 (>3.72).

Additionally, most comments are highly positive. Many users recognize the value of the knowledge conveyed through the channel and are highly appreciative that a dermatologist offered evidence-based knowledge on social media. Some representative comments are the following:

"Hello, you are amazing, I found you on YouTube quite desperate for my acne-prone skin and buying products hoping they would be miracles.... And I've been applying the information you give us to my routine. I started in October of last year and now I can tell you that I have the best skin I ever had."

"Since watching your videos, I use sunscreen regularly."

"I am definitely addicted to your videos, your advice on skin care and everything you always explain with scientific rigor are priceless. Of all the Dermatologists that I follow, without a doubt, you are the one that best explains yourself and the most humble when doing so. Thank you very much because everything I have applied thanks to you has helped me to

improve the health of my skin and to better understand its needs. A hug from Malaga and that everything that we you give you get it x1000"

"Great video, like all of them. Great professionalism and pleasant presentation."

Moreover, apart from patients, physicians such as general practitioners are also thankful for the content shared, and have expressed that it is very helpful for medical education on non-dermatologist physicians, and to aid in dermatological care in regions or medical centers without dermatologists. A comment that is illustrative of this is the following:

"You rock!!! I am a second year Family Medicine resident, and my tutor and I are hooked to all your videos. My favourite time of the week is commenting on your video of the week with him, also we work in a county that has no dermatologist.... We are always recommending you to our patients, friends, family.... And they love you! Plus we are learning a ton and helping our patients."

Keep it up, thank you for the knowledge you transmit and congratulations for all your hard work.

5.2.2 Instagram

YouTube is the most appropriate social media platform to transmit educational messages, because it is focused on longer videos in which a topic can be developed. Therefore, YouTube was the main social media platform developed for this thesis.

However, due to the growing importance of Instagram, and the preference of a big part of the population (especially younger people) for shorter formats, a profile on this network was also designed and developed.

To date, over 280 posts have been published, and the profile has reached over 105,000 followers. Content has been posted in picture and in short-video format about a wide range of dermatological topics, with a special focus on transmitting sun protection messages. Some of the publications have reached over 1 million views, and most of them have reached 80,000-200,000 views.

On this platform, the main age range of the audience is 25-34 years old, and over 90% of the followers are women.

1.4 Experiment on the thematic preferences of the population

The fourth objective of this thesis, namely, "systematically analyse which dermatological topics interest the public most, and to find out whether it is feasible for a dermatologist to become influential on social media while presenting all dermatological topics equally", was addressed by an experiment performed on the YouTube channel developed for this thesis.

The purpose was to conduct insider research exploring how the public reacts to the presentation of various dermatological topics by dermatologists. In other words, the aim of the experiment was to determine from the inside which dermatological topics social media users find most interesting. The aim was to be able to deduce whether it is feasible for a dermatologist to become influential on social media while presenting all dermatological topics with equal prominence, as had been suggested from a conceptual perspective.

Data were collected from YouTube Studio, a platform provided by YouTube to help content creators manage their channels. YouTube Studio provides key channel analytics to better understand video and channel performance. This research focused on a specific metric: average daily views (i.e., views/days since upload). Other metrics provided by YouTube Studio include subscribers, watch time (hours), likes, dislikes, and shares. All videos posted from 25 October 2019 to 25 October 2021 were included in the study. In total, 101 videos were posted about a wide variety of dermatological topics acne and acne scars, rosacea, melasma, hidradenitis suppurativa, psoriasis, vitiligo, hair loss, atopic dermatitis, seborrheic dermatitis, nevi, sun protection, melanoma, basal cell carcinoma, squamous cell carcinoma, polymorphous light eruption, hyperhidrosis, folliculitis, laser hair removal, keratosis pilaris, post-inflammatory hyperpigmentation, dermatological treatments such as benzoyl peroxide and isotretinoin, skin type, medical peelings, botulinum toxin, and active ingredients in cosmetics.

All videos were presented by the same dermatologist in the same setting and followed a similar approach. They were also similar in terms of duration and aesthetic design. We could assume, therefore, that the differences in the average daily video views were mostly due to the different interest of the public in the topics covered.

To categorize the videos under study, a two-step approach was followed. In the first step, videos were grouped into two broad categories: cosmetic dermatology (51 videos) and medical dermatology (50 videos). A Student's t-test was conducted to determine whether there were significant differences between the views counted for both types of videos. Despite the absence of normality in the data, the relatively large number of observations in both categories (n = 50 and n = 51, respectively) led to the use of the parametric Student's t-test.

In the second step, several subgroups were created among the medical videos. Subcategorization was performed because it was apparent that there was great variance in the views within this category. Specifically, medical videos were divided into three subgroups: acne; facial dermatoses, excluding acne; and other dermatological diseases. This arrangement was based on the empirical observations of the author of this thesis. Overall, it was observed that acne and, to a lesser extent, other facial dermatoses, such as rosacea and melasma, generated more views than other dermatological diseases. This may be because self-care is erroneously considered feasible for these conditions. Additionally, facial dermatoses are highly visible, with substantial social repercussions (Orion et al., 2014; Kouris et al., 2018; van Zuuren et al., 2021). An individual category was established for acne because of its particularly high prevalence and because it markedly affects adolescents and young adults, who comprise YouTube's largest user base (Sierro et al., 2022; Zheng, Ning et al., 2021; Yousaf et al., 2020). Then, a non-parametric Kruskal-Wallis rank test was performed to compare the three medical categories and cosmetic videos. This non-parametric test was chosen due to the absence of normality in our data and the relatively scarce number of videos in some categories.

The videos had been published on different dates, which implies that they had had different opportunities to be viewed. Therefore, the videos were not compared in terms of total views but in terms of average daily views.

1.5 Experiment on the factors influencing audience retention

The fifth objective of this thesis, namely "determine which factors influence audience retention on a dermatologist-led social media channel and provide insights that can help dermatologists create engaging content that becomes successful", was addressed by a second experiment performed on the YouTube channel developed for this thesis.

The study focused on audience retention on YouTube and its explanatory factors. The goal was to answer the following research question: What factors influence audience retention on a dermatologist-led YouTube channel?

The study period for this experiment was 2 years and 9 months. Data from the 137 videos posted during the studied period was used, obtained from the YouTube analytics application programming interface (API). These data are not publicly available but provided by YouTube only to the video creator in the YouTube Studio.

The data analysis followed a two-step process. First, the overall measures of audience retention of each video were explored. Multiple linear regression was used to test whether the specific characteristics of the video significantly predicted audience retention. The examined variables included video length, days since video release, viewers, likes, dislikes, shares, gained subscribers and comments. As a preliminary step, the correlations between these variables were examined.

Second, audience retention graphs were analysed in detail to identify spikes. An upward change was considered a spike when it was greater than or equal to 5%. The spikes were subjected to content analysis to determine what was of particular interest to the public. Content analysis was performed by labelling spikes into different categories. As the videos were educational, the categories chosen were the two different types of knowledge that the videos could convey: conceptual and procedural (Krathwohl, 2002). However, during the labelling process, a third category of spikes was found, which corresponded to moments of transition. This process is explained in detail in Figure 10.

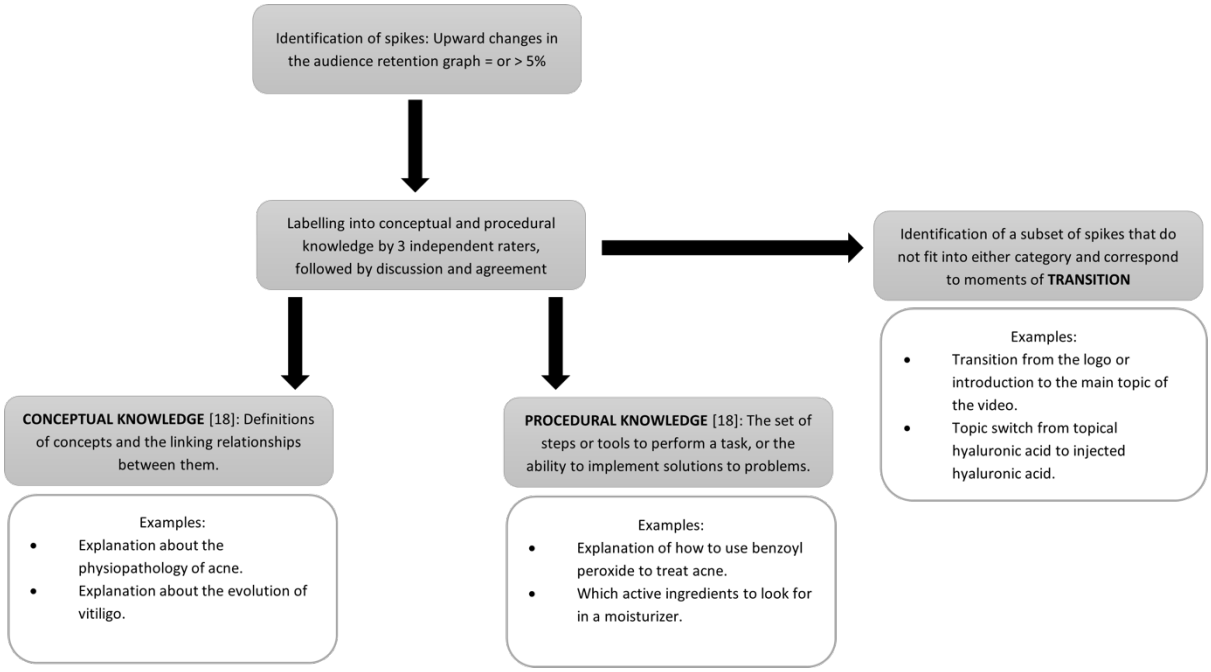


Figure 10. Process of spike identification and labelling.

The labelling of the spikes was performed independently by three raters. Afterwards, the labels were discussed and agreed upon. Before the discussion, the Fleiss' kappa coefficient was 0.91.

6. Summary of results

The results presented in this summary are intended to provide a general overview of this thesis' research outcomes. These results are not exhaustive and should not be considered as a substitute for the complete studies, which are reported on Part II, Sections 1, 2 and 3. The Tables 2-14 and Figures 11-12 shown below are taken from the publications listed in Part II.

6.1 Benefits, drawbacks and challenges of social media use in dermatology

First, a descriptive analysis of the selected studies was performed to determine the number of publications per journal and the number of publications per year.

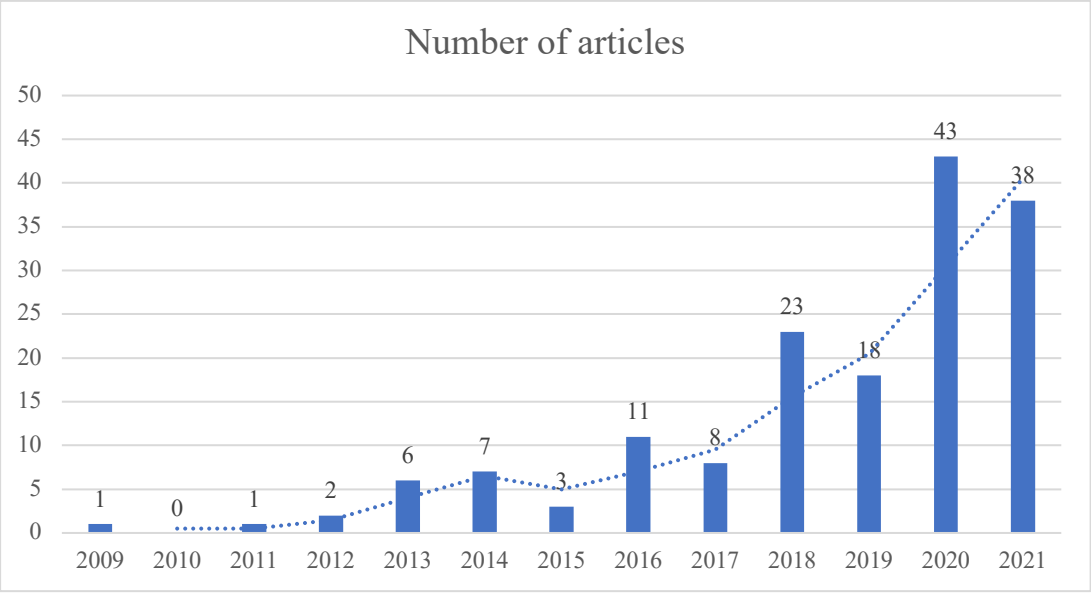
The articles were published in 53 journals. Most were published in the Journal of the American Academy of Dermatology (JAAD), followed by the Dermatology Online Journal,

the International Journal of Dermatology and Clinical and Experimental Dermatology (see Table 2). The number of publications increased each year (see Figure 11).

Table 2. Number of publications per journal from 2009 to 2021.

JOURNAL	NUMBER OF ARTICLES	%
Journal of the American Academy of Dermatology	31	19.25
Dermatology Online Journal	19	11.8
International Journal of Dermatology	7	4.3
Clinical and Experimental Dermatology	7	4.3
Pediatric Dermatology	6	3.73
Journal of Dermatological Treatment	5	3.1
Cutis	4	2.48
Journal of Medical Internet Research	4	2.48
Archives of Pathology & Laboratory Medicine	4	2.48
Journal of Cosmetic Dermatology	4	2.48
Dermatologic clinics	4	2.48
JAMA Dermatology	3	1.86
JMIR Public Health and Surveillance	3	1.86
Actas Dermo-Sifiliográficas	3	1.86
Journal of Drugs in Dermatology	3	1.86
Cureus	3	1.86
Dermatology	3	1.86
Archives of Dermatological Research	3	1.86
Dermatologic Therapy	2	1.24
Seminars in Cutaneous Medicine and Surgery	2	1.24
Journal of Investigative Dermatology	2	1.24
JDDG: Journal der Deutschen Dermatologischen Gesellschaft	2	1.24
The Journal of Clinical and Aesthetic Dermatology	2	1.24
The Journal of Allergy and Clinical Immunology: In Practice	2	1.24
Translational Behavioral Medicine	2	1.24
Australasian Journal of Dermatology	2	1.24
British Journal of Dermatology	2	1.24
Clinics in Dermatology	2	1.24
Others (25) *	25	15.5
Total	**161**	**100**

Figure 11. Number of publications per year.



Note: In the case of 2021, publications were only taken into account up to July.

Additionally, a content analysis of the reviewed articles was conducted according to the following structure: First, the different social media platforms used in dermatology were reviewed. Second, the benefits, drawbacks and challenges of social media use in dermatology were identified. Fifteen benefits, eleven drawbacks and ten challenges of social media use in dermatology were identified and discussed. Suggested strategies to address the identified drawbacks were provided.

6.1.2 Social media platforms in dermatology

Table 3 comprises a detailed overview of social media platforms in dermatology.

Table 3. Social media platforms in dermatology.

Social media platform	Description/Content type	Reach/ Repercussion	Dermatological content	Potential	Challenges and future strategies
YouTube	2005 – Present. Description: Open-access video-sharing platform. Content type: Long videos > short videos.	Second most accessed website worldwide, with more than two billion active monthly users.	• Vastly available. • Descriptive analysis of videos covering dermatological topics: over 47 million views. • One of the most popular categories is 'How-to' videos, which show patients how to take care of healthy skin or their dermatological disease.	• YouTube's influence on health-related decision-making has already been demonstrated. • The WHO has explicitly recommended the use of this platform for patient education due to the high demand for dermatological content.	• Wide presence of videos that disseminate unscientific, misleading and even harmful information. • Scarce presence of dermatologists, academic journals and health organizations. • Absence of referral to sources of information. • Negative correlation between video quality and the number of likes it receives: Low-quality videos are more highly rated than high-quality videos. • It is important to increase the number of high-quality videos and their attractiveness.
Instagram	2010 – Present. Description: Free mobile photo- and video-sharing service. Content type: Photos > short videos. 'Hashtags' are used to indicate the subject of the post and to link it to other posts of the same subject.	Over 1 billion users every month, > 90% under the age of 35.	Half of the posts are educational, a third are personal posts, and the remaining are accomplishment and advertisement posts. A smaller study found that most posts were advertisements.	• Especially useful to educate young people. • Useful tool for dermatologists to share challenging cases with colleagues over the world. • It can help dermatologists build a brand image and increase patient referrals.	Dermatologists produce a very small proportion of dermatological posts.
TikTok	2016 – Present. Description: Free mobile video-sharing network. Defined as the world's fastest growing social media platform.	Used by a younger segment of the population, mainly teenagers.	Due to the audience profile, most content focuses on acne.	• Unlike other social media platforms, in which content is mainly shared with followers, TikTok's algorithm suggests videos on similar topics to the	The literature suggests that dermatologists should take this opportunity to educate young patients on acne, a topic in which the prevalence of misinformation on the Internet is vast.

	Content type: Short, catchy videos.			ones users have recently watched. This algorithm makes it easier for dermatologists' videos to spread among skincare videos. • Another useful feature is the duet function: It allows dermatologists to respond to other users' videos with their own, which can be an effective tool to dispel misinformation.	
Twitter	2006 – Present. Description: Free microblogging platform. Content type: Short messages with a maximum length of 280 characters, known as tweets. Although the length is limited, tweets can include links and images.	Used by many leading dermatology journals (British Journal of Dermatology, Journal of the American Academy of Dermatology).	53% of posts include personal content, 43% include educational content and 3% are advertisements.	• Useful to enhance journal readership and create online journal groups. • It can be used for patient education and health promotion, and to study the attitudes of the population toward preventable disease caused by behaviors such as tanning bed use, providing insight for health campaigns. • Useful tool for patient organizations or peer communities, providing support and education for patients.	Several studies conclude that it could be used for medical education, dissemination of research findings, and international collaboration among physicians.
Facebook	2004 – Present. Description: Free platform in which users can share pictures, videos, life events or accomplishments. It requires reciprocity, which means a user has to accept other users as Facebook friends so that they are able to see their posts. Content type: Pictures, videos, text.	Biggest social network worldwide, with 2.89 billion monthly active users in the second quarter of 2021.	Groups for continuous medical education, such as dermoscopy groups. Patient advocacy groups.	• It allows the creation of groups focused on common interests, which provide a useful platform for discussing professional issues or for continuing medical education, such as groups focused on dermoscopy or dermatopathology. • Useful for creating patient groups; it facilitates peer support.	It has been suggested that personal Facebook profiles should not be used for professional purposes, and physicians should not accept patients as Facebook friends. A Facebook page, also called a business page or fan page, is more appropriate for this purpose because it is not connected to the user's personal profile and because there is no limit to the number of followers or fans it can have.

Reddit	2005 – Present. Description: Free website with a forum-based interface, centered on building communities for individuals with similar interests who can share information. Its structure comprises multiple user-generated subreddits that act as forums. Content type: Text, links, images and videos.	As patients use this network for crowdsourcing of dermatologic consults and attempting self-diagnosis, it has been argued that it could be an especially appropriate site to disseminate accurate information.	Multiple subreddits about skincare, acne and other dermatological diseases.	It allows geographically dispersed individuals to discuss common interests.	It can be useful for dermatologic research and engagement with the public, especially for common dermatology topics such as acne, psoriasis and tanning.
Tumblr	2007 – Present. Description: Microblogging platform that allows users to post multimedia and blogs. Content type: Text, links, images and videos.	As of July 2021, it hosts more than 529 million blogs.	Scarce.	Resource for information dissemination and interaction with the public for dermatology journals and professional groups.	It lacks the presence of dermatology journals and organizations.
Pinterest	2009 – Present. Description: Users create and share individual bookmarks called 'pins' and group them into larger collections called 'boards' that include pins related to the same subject. Content type: Pictures > short videos.	478 million monthly active users in 2021. 80% women.	Informative pins and boards are the most common (approximately half of the content), which could represent a desire by users to access quick, easy to read information or short summaries. Sun protection pins are the most common type of dermatology pin (31.1%).	It allows patients, organizations, and businesses to collect and share ideas related to projects or interests.	Only 24% of boards are created by healthcare professionals, and dermatology journals have little presence, with only one board posted by JAMA Dermatology.
Snapchat	2011 – Present. Description: Free mobile network that allows sharing of videos and photos that last 24 hours, called 'snaps'. Content type: Pictures and short videos.	306 million daily active users worldwide in 2021.	Scarce.	It can be used as a marketing tool to reach millennials, which is the segment of the population that is most present on this network.	Most dermatology journals, professional organizations and patient advocate groups are not present on Snapchat, probably because the brevity of the 'snaps' renders it less useful than other platforms to spread dermatology-related information.
LinkedIn	2003 - Present. Description: Free platform that allows users to set up a	Over 700 million users worldwide in 2021.	Professional profiles and job offers.	Useful for dermatologists to find job offers and for networking.	It can provide professional opportunities to dermatologists, but it is

	professional profile, find job offers and establish a network of professional contacts. Content type: Information on work experience and education.				not a useful network for patient education or health promotion [11].
WeChat	2011 - Present. Description: Free network that started as a messaging app but has evolved into a comprehensive platform that provides many services, such as Intelligent Healthcare. Content type: Text, photos, videos, healthcare.	Most popular social media application in China, with more than 1 billion monthly active users in 2020.		It provides Intelligent Healthcare, which allows users to find healthcare professionals, arrange consultations and pay medical bills.	
Google+	2011 – 2019. Description: Free network that allowed photo-sharing, joining communities and linking user's properties across the web. Content type: Text, photos, videos, links.	Over 395 million active members in 2017.	Not broadly used by dermatology journals or associations, with JAMA Dermatology being the only active journal in 2017.	Compared to other social networks, its main advantage was that it granted tools for search engine optimization, which meant that users could potentially reach a bigger audience.	
Flickr	2004 – Present. Description: Free platform that allows photographers to host high-resolution photos. Content type: Photos > videos.	At the start, it quickly become very popular, but since then it has progressively lost many of its users.	In 2018, none of the top dermatology journals had an account, and the only professional association on this network was the European Academy of Dermatology and Venereology.		
Doximity	2010 – Present. Description: Social networking platform for United States healthcare professionals and medical students. Content type: Informative articles.	Used by almost two million medical professionals in 2021.	Informative articles on general topics such as 'sunscreen recommendations' and 'advice from dermatologists,' and research articles.	It provides dermatologists with professional networking opportunities.	Content on general topics can be shared to other social media platforms to educate patients.

6.1.3 Benefits of social media use in dermatology

Fifteen benefits were identified, which are summarized in Table 4 and discussed below.

Table 4. Benefits of social media use in dermatology.

	BENEFITS	DETAILS	EXAMPLES
1	**Dissemination of accurate information to counteract misinformation**	• Dispel false and potentially harmful information from unqualified sources and help patients make educated decisions. • Provide references for the content shared. This ensures that patients have access to the most accurate and complete resources.	• On YouTube, viewers are likely to watch several videos on the same topic, so it is crucial that the number of videos posted by professionals is enough to neutralize the misleading ones. • There has recently been an alarming rise in the popularity of 'natural' or homemade sunscreens. The idea that these products are safer should be counterbalanced by the proactive engagement of dermatologists to inform people about their lack of efficacy and the risk of skin cancer.
2	**Business: Providing top-quality service and improving marketing performance**	• Demonstrate the procedures performed at the practice. • Make it become a trusted source of medical information. • Build brand loyalty. • Reach larger audiences at a lower cost. • Understand patient needs and demands and adjust services. Traditionally, patient surveys were the only tool to gather this information, which were less accurate due to patients' lack of motivation to answer them. Now, qualitative content analysis can be used to analyze patients' comments on social media, which is information that patients have chosen to post themselves and that might therefore be more honest and reliable. • Manage patient dissatisfaction by publicly responding to bad reviews to transmit more confidence to prospective clients.	• A questionnaire-based cross-sectional study from 2020 found that the number of participants who knew their dermatologist from social media was 9.7 times higher than those who knew them from traditional sources (TV, radio, newspaper). • A survey-based cross-sectional study from the same year found that 22% of patients felt that social media presence is very or extremely important when choosing a dermatologist. • Many dermatologists have successfully used social media to boost their businesses. Dr. Sandra Lee, a board-certified dermatologist based in California, has become a global social media phenomenon, with over seven million subscribers on YouTube and over four million followers on Instagram. As a consequence, she now has a successful skincare brand and a television show.
3	**Being in control of your online reputation**	Due to the contributions of others, all dermatologists have an online reputation, whether they actively engage in social media or not. Proactively participating allows them to ensure that they are in charge of the image they are transmitting to patients and colleagues.	

4	**Understand patients better**	• Opportunity to be proactive and offer advice against risky or unproven treatments shared on social media. • Understand patient attitudes toward misconceived dermatologic treatments, such as isotretinoin, based on their portrayal on social media. • Adjust patient expectations and prevent frustration. • Explore patients' unmet needs and concerns that they might be reluctant to bring up during the clinical visit.	• It allows dermatologists to be aware of homeopathic treatments on Reddit or unscientific acne treatments on TikTok. • Social media frequently inspires unrealistic expectations for acne treatments, and physicians may avoid frustration by being aware of this and explaining realistic results.
5	**Health promotion and awareness-building campaigns**	• Cost-effective way to disseminate awareness-building campaigns, reach large numbers of young people and promote healthy skin habits. • Because of the interactive format of these platforms, information is often converted into discussions, reaching even more people.	• With more than 5 billion visits per day, YouTube offers an unmatched opportunity to educate the population. • Sunburn risk has proven difficult to discourage through traditional, expensive interventions, such as school programs. Therefore, dermatological associations such as the National Academy of Sciences' Interdisciplinary Perspectives on Skin Cancer have concluded that there is a need for low-cost digital campaigns that promote sun protection in children and young adults.
6	**Improve patient quality of life**	• Studies have shown that social media may facilitate more open disclosure of symptoms experienced and treatments attempted compared to a conversation with a physician in a clinical visit due to the convenience, easy access and anonymity of these platforms. • It has been proven that patient education through social media improves the quality of life of patients with chronic inflammatory skin conditions.	
7	**Public health surveillance**	Analysis of user-generated content on social media can help physicians and health organizations understand patient perceptions and attitudes. Thematic analysis of social media posts can be a reproducible, standardized method for surveying patient experiences.	A content-analysis study performed in 2016 showed that Twitter data provides insight into tanning behaviors and injuries not captured through traditional public surveillance.
8	**Source of new research gaps**	• Dermatologists may find scientific gaps that need further research by analyzing social media data. • Social media can also be used to perform scientific studies due to the vast number of patient experiences it encompasses. For instance, content analysis can be a way to	• Reading about treatments in discussion among patients, such as tea tree oil or cider vinegar for acne, may prompt rigorous clinical studies to investigate new therapies. • A study on eczema performed in 2016 by analyzing patient-generated content on Twitter, Facebook, Instagram and Tumblr

		understand the burden of dermatologic diseases.	found that many people in the United States use social media to discuss this disease. Through patients' posts, they concluded that eczema might be associated with anticipatory anxiety, thereby suggesting a new aspect of these patients' well-being that could be quantified in future research.
9	**Drug adverse effect surveillance**	• Social media can be used to investigate rare adverse effects not captured by traditional studies. • It might also be useful to surveil the pattern and burden of more common adverse effects.	• A study from 2019 found that adverse reactions were detected on social networks with high precision and an average of seven months ahead of being reported in literature. They highlighted that even though millions of patients report health concerns on social media, this information is vastly underutilized. • A study performed in 2020 showed that the reported side effects of oral isotretinoin on Instagram accurately represented their frequency.
10	**Hospital and residency program selection for residents**	Useful tool for applicants to dermatology residency to gain insight into the distinctive features of each program, read reviews and find rankings.	• Active engagement on social media is seen favorably by applicants. It offers a support network and transparency. • Social media use by residency programs grew in 2020, accelerated by limited in-person interactions due to the COVID-19 pandemic. Instagram presence grew from 7% in 2019 to 45.6% in 2020.
11	**Education and networking for dermatologists and dermatology residents: Improved healthcare**	• The COVID-19 pandemic has heightened the necessity for digital alternatives to medical education. • Inexpensive resource that offers a venue for professional conversation on a global scale, facilitating international learning and collaboration, without the formality and costs of conventional meetings. This can improve research, as it allows access to the most current and relevant information worldwide. • It can facilitate the sharing of expertise and reaching an accurate diagnosis in complex cases, lessening inappropriate treatments and delayed referrals to the correct specialist.	• The Dermatology Journal Club on Twitter (@DermatologyJC) allows residents and dermatologists to engage in literature discussion. • In a study from 2018, 80% of dermatopathologists agreed that cases seen on social media are useful and relevant to their practice.
12	**Education for medical students**	• It constitutes an enjoyable and convenient tool for studying that improves knowledge retention. • It can aid communication between students and professors.	• A study carried out in Ohio in 2016 found that optional online quizzes with small incentives may foster motivational competition among students, increase online interactions with faculty and serve as study material for exams. • Another study carried out in Syria in 2018 concluded that creating an educational WhatsApp group had a positive effect on

			examinations, as more participation in the group correlated with higher scores.
13	**Expand access to dermatologists and to better dermatological care**	Collective intelligence through social media could potentially increase the diagnosis accuracy of non-experts and improve the care received by patients in areas without dermatologists.	Sharing photographs and photomicrographs of skin lesions on social media-based professional groups allows dermatopathologists from around the world to view cases and share their diagnostic opinions.
14	**Patient advocacy**	• Patients with common interests can connect and create support networks on social media in which they can communicate their problems, encourage each other and learn from their peers. • The most used platforms for this purpose were Facebook (78%), Twitter (64%) and YouTube (53%). • These online communities are especially important for patients with chronic illnesses, such as rosacea, and for diseases that generate embarrassment and are difficult to share in person or discuss with physicians.	• A study performed in 2019 on Instagram and Twitter analyzed patients' posts after Mohs surgery and found that by sharing personal experiences, patients may experience catharsis through social media platforms. • In a survey-based study from 2019, active members of psoriasis-related Facebook groups deemed Facebook helpful for coping with psoriasis.
15	**Journals: Increase impact factor and reach**	• There is growing evidence that supports that engagement of scientific journals on social media has a positive effect on content citations and therefore on the journal's impact factor. • The number of followers that relevant dermatological journals have on the main social media platforms is increasing, which reflects the interest of the scientific community and the population in this new format. • Journals can post varied content, such as extracts from specific articles, tables of contents, clinical cases and updates. • An analysis of the JAAD's Facebook page found that photo posts receive more engagement than links, videos and text-based updates, accounting for 93% of the most engaging posts on Facebook.	• The Journal of Investigative Dermatology (JID) recently established dedicated social media editors with the goal not only of sharing information on these networks but also creating an environment for global, cross-disciplinary debate. • The Journal of the American Academy of Dermatology (JAAD) started a new Virtual Journal Club on Facebook to create active discussion around forefront research. • Other journals, such as the International Journal of Dermatology, use Twitter to publish highlights of articles. • Some journals, such as the Journal of Cutaneous Medicine and Surgery, allow authors to present their research in the form of video files, as well as in text, by linking to YouTube from within published articles. These videos undergo peer review in the same way as conventional written publications. • The profile of the JAAD on Instagram had 27,000 followers in an analysis performed in March 2020, and by December 2021, it had reached over 48,000 followers.

Benefit 1. Dissemination of accurate information to counteract misinformation

There is a vast quantity of dermatologic information on social media, and many studies have demonstrated that a considerable part of it is not based on scientific evidence (Zheng, Ning et

al., 2021; Chen et al, 2021; Reuter et al., 2021). Therefore, dissemination of accurate information by dermatologists is essential to promote proper skin habits, dispel false and potentially harmful information and help patients make educated decisions (Long et al., 2022; Rafferty et al., 2021; Sierro et al., 2020). Dermatologists can share evidence-based videos or posts, allowing patients to post questions or doubts and providing evidence-based responses (Travers et al., 2012; Buntinx-Krieg et al., 2017). Dermatologists can also regularly remind patients of what constitutes a trustworthy source of information (Inagaki et al., 2021). This is of great importance because a survey-based study (Croley et al., 2019) found that 90% of millennials trust healthcare information on social media.

Benefit 2. Business: Providing top-quality service and improving marketing performance

Social media can be very useful for marketing a dermatology practice by building brand loyalty (Wong et al., 2019; Ross et al., 2015) and reaching larger audiences at a lower cost (Klietz et al., 2020). Several studies (Schoenberg et al., 2020; Albeshri et al., 2020; Murphy et al., 2020; Nguyen et al., 2018) have shown that patients' choice of dermatologist is greatly influenced by social media.

Benefit 3. Being in control of your online reputation

All dermatologists have an online reputation, whether they actively engage in social media or not (Taberner et al., 2016). Proactively participating in social media allows dermatologists to actively control the image they transmit to patients and colleagues (Sun et al., 2021; George et al., 2012).

Benefit 4. Understand patients better

Using social media allows doctors to better understand patients and offer better care. Being aware of the information patients access online allows dermatologists to be proactive and offer advice against unproven treatments (Zheng, Ning et al., 2021; Okon et al., 2020). It also allows dermatologists to understand patients' attitudes toward misconceived dermatologic treatments, such as isotretinoin (Zheng, Ning et al., 2021), and to adjust patients' expectations to avoid frustration (George et al., 2012; Reddy et al., 2021; Okon et al., 2020).

Benefit 5. Health promotion and awareness-building campaigns: High reach, low cost

Social media is a cost-effective way to reach large numbers of people and promote healthy skin habits (Mueller et al., 2019). The broad use of social media by teenagers and young adults

implies that campaigns performed through these platforms can educate patients early on and aid in the prevention of sun damage (Nguyen et al., 2018; Sarkar et al., 2018). Recent campaigns have shown that social media engagement is a promising way to reduce indoor tanning among young adults (Yousaf et al., 2020). This is especially important if we bear in mind that melanoma is the second most frequently diagnosed cancer in people aged 15–29 years (Endly et al., 2013).

Benefit 6. Improve patient quality of life

The convenience and anonymity of social media may facilitate more open disclosure of symptoms experienced and treatments attempted. This can result in improved patient care and quality of life (Ricklefs et al., 2016; Cardwell et al., 2018). Patient education through social media improves the quality of life of patients, as demonstrated for chronic inflammatory skin conditions (Cardwell et al., 2018).

Benefit 7. Public health surveillance

Analysis of user-generated content may add information that is not captured through traditional research methods (Seidenberg et al., 2016; Kamath et al., 2013).

Benefit 8. Source of new research gaps

Dermatologists may use the vast amount of social media data to identify scientific gaps (Okon et al., 2020) and perform scientific studies (Wang et al., 2017).

Benefit 9. Drug adverse effect surveillance

Social media can be used to investigate rare adverse effects not captured by traditional studies (Wehner et al., 2014; Nikfarjam et al., 2019) and to surveil the patterns and burden of common adverse effects (Alex et al., 2020; Muralidhara et al., 2018).

Benefit 10. Hospital and residency program selection for residents

Social media is becoming increasingly important for applicants to dermatology residency to gain insight into the features of each program, read reviews and find rankings (St Claire et al., 2019; Tapking et al., 2020; Hu et al., 2020).

Benefit 11. Education and networking for dermatologists and dermatology residents: Improved healthcare

The visual nature of dermatology makes it especially easy to integrate on social media for educational purposes (Sun et al., 2021). It is an inexpensive resource that facilitates international learning and collaboration (Schoenberg et al., 2020; Amir et al., 2014; Shmuylovich et al., 2020; Zheng et al., 2021), improving research and management of complex cases (George et al., 2012; Schoenberg et al., 2020). The COVID-19 pandemic has heightened the necessity for digital alternatives for medical education (Wong et al., 2019; Zheng et al., 2021; Ko et al., 2017; Martin et al., 2020).

Benefit 12. Education for medical students

Social media provides distinctive options, such as online quizzes (Kunzler et al., 2016) or WhatsApp groups (Alhalabi et al., 2018), that increase students' enjoyment and participation, leading to improved knowledge retention (Guckian et al., 2021) and academic achievement (Alhalabi et al., 2018).

Benefit 13. Expand access to dermatologists and better dermatological care

Access to a dermatologist is not readily available in many parts of the world. Collective intelligence through social media could potentially address this public health problem (Rinner et al., 2020; Madke et al., 2018).

Benefit 14. Patient advocacy

Patients with common interests can connect and create support networks on social media (Sun et al., 2021; Zeichner et al., 2016; Patel et al., 2018; Iglesias-Puzas et al., 2021; Cheng et al., 2020). These online communities are especially important for patients with chronic illnesses and diseases that generate embarrassment (Cardwell et al., 2018; Golbari et al., 2019).

Benefit 15. Journals: Increase impact factor and reach

The use of social media to disseminate research is increasing. Engagement of scientific journals on social media has a positive effect on content citations and, therefore, on the journal's impact factor (Jia et al., 2020; Wei et al., 2021). Some authors have concluded that the potential of Facebook and other social networks in the field of medical journals exceeds all the tools used for this purpose to date (Endly et al., 2013).

The number of major dermatology journals that are active on social media has grown significantly in the last five years (Karimkhani et al., 2014; Molina-Ruiz et al., 2013). Journals are increasingly aware that it can be difficult for busy dermatologists to keep up with advances

in the field and, therefore, they are striving to create easily accessible and engaging tools (Altman et al., 2020; Barber et al., 2016).

6.1.4 Drawbacks of social media use in dermatology and suggested solutions

Eleven drawbacks were identified, which are summarized in Table 5 and discussed below. Suggested strategies to address these drawbacks were provided.

Table 5. Drawbacks of social media in dermatology and suggested solutions.

	DRAWBACKS	DETAILS	SUGGESTED SOLUTION
1	**Potential risk for patient privacy and confidentiality**	**1.** Patients ask about their individual dermatological problems on physicians' social media profiles, and confidentiality cannot be guaranteed if communication is performed through messages on these networks. **2.** Many dermatologists post pictures of patients to illustrate diseases or show treatment results, which could potentially compromise patient privacy.	**1.** The literature suggests that these platforms can be used safely as long as the same ethical standards used in traditional settings are maintained. Dermatologists should let patients know that a consultation can never be based on an exchange of messages on social media. **2.** Some authors argue that this is not different from discussing cases at conferences or publishing them in journal articles or textbooks, which are also public materials that can now be easily accessed online. Common sense and patient privacy principles should be applied. For example, dermatologists should not promote financial incentives for procedures in exchange for providing consent to disclose sensitive health information, such as pictures.
2	**Negative impact on the patient-physician relationship**	Many patients actively search for second opinions on social media after seeing a dermatologist, which could result in acceptance of unqualified recommendations and negatively affect the patient-dermatologist relationship.	• In an online survey performed in 2015, the main reasons for searching for medical information online were to complement information provided by the physician that patients regarded as appropriate (67.3%) and to gather information before the consultation with the physician (36.5%). Therefore, the authors concluded that looking up dermatological information online is not associated with a poor patient–dermatologist relationship. • In an online survey posted on Facebook groups of dermatological patients in 2019, only 3.1% of patients answered that the reason for looking for dermatological information on social media was not trusting their dermatologist. • In a more recent questionnaire-based study from 2020, 81.4% of patients reported that their online search for medical information had no effect on the patient-physician relationship, 16%

			noticed an improvement and only 2.6% perceived a worsening.
3	**Hard to fit into a dermatologist's schedule**	• Maintaining active social media profiles is complex and time-consuming, as content has to be posted regularly. This can be hard to fit into dermatologists' generally overburdened schedules.	• Choosing one or two social media platforms and focusing on them. • Hiring someone to build a social media presence.
4	**Risk of attempting self-diagnosis**	The visual nature of dermatology allows patients to use the Internet as a tool to attempt self-diagnosis or to post pictures of their lesions on social media looking for crowd-diagnosis.	The rapid growth of these activities suggests an exponential demand for telemedicine and online medical advice that should be addressed by dermatologists.
5	**Misinformation. Patients cannot discern good information from bad information.**	• Anyone with access to the Internet can publish unverified information, even without being qualified to do so. An analysis of Instagram hashtags found that most top dermatology-related posts are made by individuals without formal dermatology training. • Many studies have noted a vast presence of inaccurate or low-quality dermatological information on different social media platforms. • Inaccurate videos and posts receive greater engagement than evidence-based content.	• Engagement by dermatologists is needed to counteract the abundant amount of low-quality information on social media. • Care should be taken when posting information based on professional opinion alone, and rigorous evidence should always be cited. • Sensationalism should always be avoided, even at the expense of losing engagement, as it leads to false expectations and dissatisfaction. • In addition to contributing content, physicians should also help direct patients to evidence-based online resources.
6	**Propagation of harmful trends**	Social media can popularize practices that produce skin harm, such as engaging in self-injury to gain social acceptance. It can promote dangerous challenges, such as the 'sunburn challenge' on TikTok, which encourages users to post videos of severe sunburn, or the 'mole removal' on the same platform, which advocates for at-home mole removal methods.	The literature suggests that the dermatology community should actively try to discourage these trends by posting about their potential risks and disseminating healthy skin habits.
7	**Access to medication without a prescription**	Social media can serve to illicitly market prescription acne medications. Zeichner et al. found that a Google search using the term 'isotretinoin online' provides links to many online pharmacies where this drug can be purchased without a prescription.	Due to the growing success of this type of illicit marketing, it is important that dermatologists ask patients what resources they use to learn about acne and offer to answer questions regarding its treatment.
8	**Risk of distraction during working hours**	As social media profiles can be updated at any time, including at the workplace, constant attention to these networks might reduce physicians' efficiency at work and even have adverse effects on patient care.	The same common sense and patient safety rules that are generally applied should be applied to social networks.
9	**Lower self-esteem of patients**	• Social media platforms offer the option to edit and add filters to photographs, which can lead to unreal, altered standards of beauty. This can result in body dissatisfaction and lower self-esteem and can lead to an increased desire to undergo dermatological cosmetical procedures. The term 'Snapchat dysmorphia' has been used to describe the phenomenon of patients seeking cosmetic surgery to look like the filtered versions of themselves. • Martel et al. found that skin lesions are the most commonly edited feature among young adults, in comparison with teeth whitening and body shape. This indicates that skin health has a	The literature suggests that dermatologists should participate in social media to educate patients who are editing photographs and seeking dermatological care.

		particularly relevant effect on self-perception.	
10	**Age and socioeconomical barriers**	• It has been postulated that an important limitation of social media is that its potential educational benefits are restricted to young people because the elderly do not access it. • Another suggested potential limitation to accessing these networks is low socioeconomic status.	• A study performed in 2020 found no correlation between age and social media use for medical information. The authors noted that this might indicate that elderly patients are increasingly using these platforms. • In 2018, Miller et al. concluded that the rapid growth of smartphone access is narrowing this socioeconomic gap.
11	**Misconceptions about dermatology**	• 83% of the content produced by the top 10 dermatology influencers on Instagram, YouTube and Twitter focuses on cosmetic dermatology. • This may translate into a public perception that dermatologists spend most of their time performing cosmetic procedures, which contrasts with data indicating that only 10% of a dermatologist's patient care hours are dedicated to cosmetic dermatology, while the rest are spent on managing medical conditions or performing surgery.	It has been suggested that more dermatologists should participate in social media and showcase the broad spectrum of the specialty, such as interesting medical cases, dermoscopic and histologic images or commentaries on medical literature.

Drawback 1. Potential risks to patient privacy and confidentiality

Two aspects may compromise patient confidentiality on social media. First, many patients ask about their dermatological problems on physicians' social media profiles. Patient confidentiality cannot be guaranteed if communication is performed through messages on these networks (Galadari et al., 2018; Freitag et al., 2017). Second, many dermatologists post pictures of patients to illustrate diseases or show treatment results (Carlquist et al., 2018; Orenstein et al., 2017). While recognizing these drawbacks, several authors (Freitag et al., 2017; Mazer et al., 2018) have concluded that social media is a continuum of human communication that has only minimal risk as long as the same patient privacy principles applied in other settings are maintained.

Drawback 2. Negative impact on the patient–physician relationship

Many patients search for second opinions on social media after seeing a dermatologist, which could result in the acceptance of unqualified recommendations and a negative impact on the patient–dermatologist relationship (Chu et al., 2021; Uppal et al., 2020). However, several studies (Gantenbein et al., 2020; Orgaz-Molina et al., 2015; Schoenberg et al., 2020) have proven that looking up dermatological information online is not associated with mistrust. Patients still regard physicians as the most important source of health information (Gantenbein et al., 2020).

Drawback 3. Hard to fit into a dermatologist's schedule

Maintaining active social media profiles is time consuming. It requires many hours of preparation to make high-quality content, including time spent reviewing literature, writing or filming content and editing it into a format that users find engaging (Klietz et al., 2020). This can be hard to fit into dermatologists' schedules (Freitag et al., 2017).

Drawback 4. Risk of attempting self-diagnosis

The visual nature of dermatology allows patients to use the Internet as a tool to attempt self-diagnosis or to post pictures looking for crowd-diagnosis (George et al., 2012; Chu et al., 2021). The rapid growth of these activities suggests an exponential demand for telemedicine and online medical advice, which should be addressed by dermatologists (Chu et al., 2021).

Drawback 5. Misinformation—Patients cannot discern good information from bad information

Medical information online is not subject to peer review or content regulation. Anyone can publish unverified information (George et al., 2012; Gantenbein et al., 2020; Taberner et al., 2016; Guzman et al., 2020; Zhou et al., 2018). Many studies have noted a vast amount of inaccurate or low-quality dermatological information on social media (Roche et al., 2021; Mueller et al., 2019; Gorrepati et al., 2021; Iglesias-Puzas et al., 2021; Chen et al., 2021; Pithadia et al., 2020; Tamminga et al., 2021; Nickles et al., 2022; Carrington et al., 2022). In an analysis of 385 posts on Facebook, Twitter, Pinterest and Reddit, Iglesias-Puzas et al. (2021) found that 44.7% of posts were imprecise and 20% were confusing. Mueller et al. (2019) classified 63% of YouTube videos on psoriasis as misleading or dangerous. Other studies on psoriasis reached similar conclusions. Mueller et al. (2020) and Gorrepati et al. (2021) found that YouTube videos on eczema were of poor scientific quality. Moreover, Mueller et al. classified 48% as misleading and 34% as potentially harmful. Chen et al. (2021) found that 71.7% of videos on rosacea came from non-healthcare sources and received more likes and greater engagement than those published by healthcare professionals. Videos criticizing medical treatments and consultations with physicians receive significantly more views than those encouraging patients to see a medical professional. Videos on acne, vitiligo and dermatological procedures are also frequently low-quality and generated by unqualified users.

Misinformation has also been found abundantly on social media platforms other than YouTube. Roche et al. (2021) and Zheng et al. (2021) found that most acne-related TikTok videos are generated by teenagers or unqualified 'skincare influencers' who receive sponsorships from brands to promote their products, which results in serious content quality shortcomings. Consequently, these authors recommend that dermatologists engage on TikTok to create thorough educational videos on acne. An analysis of tweets about tanning on Twitter (Wehner et al., 2014) found that only a small percentage mentioned the health risks associated with it. On the same platform, Menzies et al. (2019) found that a significant percentage of tweets about psoriasis mentioned dietary interventions as a good therapeutic option. A study (Tamminga et al., 2021) performed on a parenting blog about sunscreen found that comments were more than twice as likely to discourage photoprotection as they were to encourage it and that sunscreen-detractive posts received higher engagement.

Inaccurate videos and posts support non-evidence-based claims and promote 'natural,' unproven therapies, such as vitamins or Ayurveda for psoriasis, restrictive diets for rosacea and acne or apple cider vinegar, radish seeds and turmeric for vitiligo. They are generally produced to direct patients toward purchasing supplements or homeopathic treatments and provide an inaccurate explanation of diseases, such as describing psoriasis as a 'liver issue' and a 'fungus inside your digestive tract'. Videos on natural remedies are more frequently watched than those on evidence-based treatments.

Drawback 6. Propagation of harmful trends

In the same way that social media can promote healthy dermatological habits, it can sadly also encourage risky practices, such as tanning (Roche et al., 2021; Young et al., 2021; Yan et al., 2019; Kanellis et al., 2020; Hossler et al., 2008). On YouTube, most videos about tanning portray it positively, and there are more advertisements for tanning salons than videos explaining its dangers (Roche et al., 2021; Young et al., 2021; Hossler et al., 2008).

Drawback 7. Access to medication without a prescription

Illicit vending of prescription acne medications on social media is growing (Urso et al., 2018). Dermatologists should ask patients where they learn about acne and offer to answer questions regarding its treatment (Urso et al., 2018).

Drawback 8. Risk of distraction during working hours

Given that social media profiles can be updated at any time, including in the workplace, Payette et al. (2013) postulated that constant attention to these networks might reduce physicians' efficiency at work and even have adverse effects on patient care.

Drawback 9. Lower patient self-esteem

Social media platforms offer the option of editing and adding filters to photographs, which can lead to unreal, altered standards of beauty (Benabio et al., 2013; Maymone et al., 2019). This can result in body dissatisfaction, lowered self-esteem and an increased desire to undergo dermatological cosmetic procedures (Benabio et al., 2013; Wang et al., 2020; Young et al., 2020; Olayinka et al., 2021).

Drawback 10. Age and socioeconomic barriers

High age and low socioeconomic status can limit access to the advantages of social media (Sierro et al., 2020). Fortunately, several studies have found that the elderly (Gantenbein et al., 2020; Sierro et al., 2020) and low socioeconomic classes (Miller et al., 2018) are increasingly using these platforms.

Drawback 11. Misconceptions about dermatology

Sierro et al. (2020) found that 83% of the content produced by the top 10 dermatology influencers focused on cosmetic dermatology. Sun et al. (2021) commented that this may generate a public perception that dermatologists spend most of their time performing cosmetic procedures, which contrasts with data indicating that only 10% of a dermatologist's patient-care hours are dedicated to cosmetic dermatology.

5. Challenges of using social media in dermatology

Six main challenges were identified, which dermatologists face in capitalizing on the benefits and mitigating the drawbacks identified in the previous sections.

Challenge 1. Need for dermatologists

Social media has a vast potential for dermatological education and can benefit innumerable patients (Mazer et al., 2018). However, dermatologists must join these networks to translate that potential into reality (Vasconcelos et al., 2020; Ranpariya et al., 2020; Reddy et al., 2021; Guzman et al., 2020; Drozdowski et al., 2021; Park et al., 2018). Gantenbein et al. (2020) found that patients would like to find more content by dermatologists on YouTube. Many

authors (Vasconcelos et al., 2020; Ranpariya et al., 2020; Reddy et al., 2021; Lenczowski et al., 2018; Pithadia et al., 2020; Zheng, Ning et al., 2021; Nickles et al., 2022; Carrington et al., 2022) have concluded that the first step in achieving the potential benefits of social media is to increase the volume of evidence-based content created by dermatologists.

Challenge 2. Need to adapt

Social media plays an increasingly significant role in a dermatologist's practice and reputation. Keeping pace with these advancements is essential to understanding patient perspectives and providing optimal patient care (Zheng, Ning et al., 2021; Alhayaza et al., 2021). In a recent survey (Alhayaza et al., 2021), 82.8% of dermatologists indicated that social media has changed the practice of dermatology.

Although many patients visit dermatologists armed with information gathered online (Zeichner et al., 2016), Gantenbein et al. (2020) found that more than 90% of patients have never been asked by their doctor whether they have searched for information online. Some authors suggest that dermatologists should ask patients about the information they have read to address misinformation (Zheng, Ning et al., 2021; Yousaf et al., 2020; Wang et al., 2020; Wang et al., 2019) and recommend reliable online sources (Zeichner et al., 2016).

Challenge 3. Managing conflicts of interest

Ranpariya et al. (2020) found that 87% of healthcare influencers perform self-promotion on social media and 32% have non-personal promotional disclosures. Promotional content might create conflicts of interest that the audience may not perceive clearly. Doctors generally appear trustworthy and honest, and patients expect unbiased recommendations from them (Ranpariya et al., 2020; Long et al., 2022). Therefore, promotional content should always be explicitly disclosed (Ranpariya et al., 2020; Zhou et al., 2018; Long et al., 2022; Muzumdar et al., 2021). However, Muzumdar et al. (2021) suggested that there may be instances in which product promotion might benefit patients. Dermatologists may promote products they believe in and that have evidence-based components, helping patients access effective treatments. These authors noted that if dermatologists completely refrain from discussing products on social media, the only available information will be shared by less qualified people, who could potentially distribute ineffective or harmful advice to the public (Muzumdar et al., 2021).

Challenge 4. Creating engaging content

The potential benefits of dermatologists' presence on social media can only be realized if content attracts users and becomes popular (Chen et al., 2021; Mueller et al., 2020; Dawson et al., 2011; Szeto et al., 2021). On social media platforms, search results are mainly ranked by relevance. For example, on YouTube, the top 3% of videos get 85% of all views. Therefore, it is critical to develop successful content to ensure visibility (Mueller et al., 2020; Gupta et al., 2020).

Some studies have been performed to determine what type of content is perceived as more attractive by users (Benabio et al., 2013; Ranpariya et al., 2020; Mueller et al., 2019; Long et al., 2022; 84,148]. Klietz et al. (2020) classified Instagram posts from a medical account with 10,500 followers into four categories: aesthetics, private life, disease and science. Private life posts received the greatest engagement, which could indicate that telling the story of the owner of the accounts is relevant and that users seem to like doctors to whom they can personally relate. Science posts failed to attract people.

Dermatologists need to deliver engaging content without compromising scientific accuracy. Evidence (Benabio et al., 2013; Ranpariya et al., 2020; Mueller et al., 2019) suggests that to increase interest in accurate dermatological content and dispel misinformation, it is necessary to adopt methods of communication that thrive on social media, such as making ‘stories’ and videos, using ‘hashtags,’ and creating interactive content (see Table 6). It is also important to publish content on common dermatological conditions that trouble a broad audience, such as acne (Buntinx-Krieg et al., 2017; Long et al., 2022) or pigmentation disorders (Long et al., 2022).

Table 6. Recommendations for creating more popular content.

1	Search engine optimization can be performed by using keywords that health seekers regularly use.
2	Post useful, original content related to your practice, such as the procedures you specialize in, areas of medical expertise, features that are unique to your practice and useful tips and information for patients.
3	Have a website or a blog that is constantly updated with customized posts.
4	Consider creating video content to post to YouTube, such as educational videos, staff biographies, patient testimonials or procedural demonstrations. Videos do not have to be professionally produced; they can be recorded with a smartphone, but they should always be clear, concise and engaging.

5	Focus on common dermatological conditions that trouble a broad audience, such as acne or pigmentation disorders.
6	Hire a social media manager or expert.
7	Interact with popular influencers with a larger reach.
8	Use comedic memes.
9	Pay close attention to recurring topics in patient feedback or comments and to how patients are describing their needs.
10	Analyze demographic data to align the social media platform you use with your target audience.

The literature suggests that dermatologists need to listen to patients' concerns and offer high-quality educational information in a way that responds to them. For example, Schneiderbanger et al. (2019) found that preventing skin aging was the main reason for sunscreen use among young females. Emphasis by dermatologists on the association between tanning and premature skin aging could contribute to increasing the use of sunscreen in this target group and aid in skin cancer prevention (Schneiderbanger et al., 2019). Skincare posts and videos are the most engaging dermatologic content across platforms, far greater than content on dermatologic diseases (Reddy et al., 2021; Buntinx-Krieg et al., 2017). Consequently, dermatologists could create content about skincare and use it to transmit additional skin health advice (Reddy et al., 2021; Buntinx-Krieg et al., 2017).

Several studies (Long et al., 2022; Morrison et al., 2019; Reynolds et al., 2019) have found that educational content is more successful when provided in an engaging and relatable manner. In 2019, Morrison et al. aimed to find out what type of skin cancer prevention video was most engaging, so they posted three different types of videos on Facebook: a parody video made by a physician influencer who shares humorous content, a video created by an Instagram celebrity and a fact-based video featuring statistics. The results showed that the parody video had the highest engagement, while the fact-based video had the lowest engagement. Reynolds et al. (2019) analyzed YouTube videos on psoriasis and biologic therapies and found that those generated by healthcare professionals had the fewest views, while individual patient testimonials had the most engagement. Chen et al. (2021) obtained equivalent results when analyzing videos about rosacea. Therefore, they concluded that, given the success of anecdotal information, doctors should consider incorporating more patient-based stories into their content (Chen et al., 2021; Reynolds et al., 2019). Additionally, they suggested that physicians should

consider encouraging viewers to ‘like’ their videos and subscribe to their channels to increase their chances of benefiting from the YouTube algorithm (Reynolds et al., 2019).

New social media platforms offer interesting resources to prevent the spread of misinformation. TikTok has a ‘duet’ feature that allows dermatologists to respond to inaccurate videos with their own, making it a very interesting tool for education in a format that users enjoy (Szeto et al., 2021).

Although several aspects have been analyzed, it is not yet completely clear what motivates patients’ choices and preferences on social media (Mueller et al., 2019; Chen et al., 2021). In addition to providing entertaining content, some authors (Mueller et al., 2020) have noted that video duration might also influence the popularity of videos: popular, low-quality videos have a much shorter mean duration than less popular, high-quality videos. It has also been argued (Mueller et al., 2020) that patients may intentionally look for alternative advice instead of searching for academic videos (see Table 7).

Table 7. Reasons that might make high-quality videos less watched than low-quality videos.

1	**Lack of entertainment.**
2	Longer duration.
3	Unrelatable.
4	Patients intentionally search for unconventional advice provided by fellow patients that diverges from established medical recommendations.
5	Patients are just unable to recognize high quality.

Studies that analyze comments posted by viewers could potentially shed light on the public’s opinions about particular videos and therefore contribute to explaining the videos’ popularity (Mueller et al., 2019; Mueller et al., 2020; Long et al., 2022). Mueller et al. (2019) suggest that it is crucial to gain insight into the characteristics of the patients who search for medical information online.

Challenge 5. Keeping content professional and ethical

Klietz et al. (2020) found that posts providing insights into private lives received the greatest engagement, as they make physicians relatable and build trust. However, it is unclear whether

it is possible to provide this type of content while preserving professionalism (Taberner et al., 2016; Wong et al., 2019; Travers et al.,2012; Klietz et al., 2020; Eid et al., 2021).

Travers et al. (2012) suggested that dermatologists can share content that reflects their personality and is not strictly related to dermatology to connect with patients, but that they should control the level of personal insight they provide. Torres et al. (2016) advised doctors who wish to share personal information online to have separate personal and professional profiles. Payette et al. (2013) noted that it is expected that patients will look up their dermatologists online, so the possibility of them finding unprofessional content should be avoided.

Additionally, it has been highlighted that when sharing dermatologic content, dermatologists should always maintain high scientific rigor and include guarantees such as credentials and references to the sources used (Taberner et al., 2016; Wong et al., 2019). Several studies (Mueller et al., 2020; Zheng, Ning et al., 2021; Gupta et al., 2020) have found major shortcomings in providing references in posts by dermatologists.

Challenge 6. Engaging with patients while not providing individual consultations

It has been noted (Zhou et al., 2018) that interacting with followers is critical to building a successful social media presence. However, the sense of closeness it creates encourages users to message dermatologists to obtain personalized medical advice (Zhou et al., 2018). Several researchers (Wong et al., 2019; Zhou et al., 2018; Long et al., 2022) suggest that dermatologists should steer clear of giving individual, personalized answers, as they may be disseminated to other users for whom the same advice might be detrimental. However, Zhou and Bercovitch (2018) indicate that ignoring questions from followers can be unethical in the paradigm of social media engagement. Wong et al. (2019) suggest that to provide an answer without responding to specific medical consultations, it may be appropriate to suggest that patients consult their dermatologists.

Challenge 7. Fitting it into a busy schedule

Managing social media takes time and commitment, which is a challenge for busy dermatologists (Benabio et al., 2013; Travers et al., 2012). Travers (2012) suggests that a good strategy might be to choose one or two social media platforms and focus on them, as this will likely be more successful than having a weak presence spread over multiple networks. Another

possible strategy for dermatologists is hiring someone to build their social media presence. However, Benabio et al. (2013) highlight that just as patients in a conventional setting trust their dermatologist because they have built a personal relationship with them, the same should apply to social media.

Challenge 8. Educating patients on distinguishing high-quality from low-quality content

Several studies (Mueller et al., 2019; Mueller et al., 2020; Dawson et al., 2011) have demonstrated that poor-quality YouTube videos generate greater engagement than high-quality videos. However, in a survey-based study performed by Gantenbein et al. (2020), patients stated that they preferred evidence-based, physician-provided dermatologic content. This contradiction could indicate that patients may encounter difficulty in identifying reliable science-based information (Gantenbein et al., 2020; Young et al., 2021). Consequently, some authors have concluded that initiatives that empower patients to adequately evaluate online resources should be considered, and patients' search behaviors should be analyzed to better target high-quality content (Gantenbein et al., 2020; Young et al., 2021).

Challenge 9. Translating health promotion on social media into long-lasting behavioral changes

Research (Correia et al., 2018; Schneiderbanger et al., 2019) suggests that compared to traditional outlets, social media represents an immeasurable, unstudied opportunity for health interventions, such as campaigns on skin cancer prevention. However, further studies are needed to evaluate the true impact and effectiveness of social media on long-lasting population behavioral changes (De la Garza et al., 2021; Morrison et al., 2019; Jhawar et al., 2019).

Challenge 10. Linking physician education and learning strategies on social media with positive patient outcomes

Social media is a useful and highly rated tool for continuing medical education, but more research is needed to understand whether this type of learning can positively affect patient outcomes (Ko et al., 2017).

6.2 Evidence on the thematic preferences of the population

The first experiment of this thesis, conducted with the aim of determining which dermatological topics interest the public most, and whether a dermatologist can become

influential on social media while presenting a balanced portray of dermatology, led to the following results.

First, a descriptive analysis of the channel analytics was performed. Data were collected from YouTube Studio, which is a platform provided by YouTube to help content creators manage their channels. YouTube studio provides key channel analytics to better understand video and channel performance. This research focuses on a specific metric: average daily views (i.e., views/days since upload). Other metrics provided by YouTube studio include subscribers, watch time (hours), likes, dislikes and shares. Data are reported in Table 8. All the videos posted from 25 October 2019 until 25 October 2021 were included in the study.

Table 8. Overview of channel analytics.

Variable	Total	Mean	SD	Min.	Max.
Views	5,504,165	54,207.82	59,750.06	939	399,436
Subscribers	134,208	1167.54	1800.94	4	13,111
Watch time (hours)	463,840	4,573.17	5,539.08	56	34,079
Likes	221,993	2,182.53	2,126.77	50	12,439
Dislikes	3,043	29.93	40.50	0	324
Shares	47,162	465.30	521.58	6	3182
Comments	17,815	175	141.47	3	771

Notes: Observations (videos) = 101. Period: 25 October 2019–25 October 2021. SD: Standard deviation. Min: Minimum. Max: Maximum.

Second, videos were categorized following a two-step approach. In the first step, we grouped videos into two broad categories: cosmetic dermatology (51 videos) and medical dermatology (50 videos). Student's t-test determined that there were no significant differences between views of cosmetic dermatology and medical dermatology videos, even though cosmetic videos had more views on average ($p = .1511$) (see Table 9).

Third, based on empirical observations, the medical videos were subcategorized into acne, other facial dermatoses and other dermatological diseases. Videos on acne had the highest average daily views (268.66), followed by videos on cosmetic dermatology (255.49) and videos on other facial dermatoses (160.18). Videos on other dermatological diseases had the lowest average daily views (91.61).

The Kruskal-Wallis rank test, which compared the three medical categories and cosmetic videos, showed that videos on acne and cosmetic dermatology received significantly more views than videos on other dermatological diseases (p =.0028 and p = .0005, respectively; see Table 9). There was a marginally significant difference (p=.0533) between views of videos on other facial dermatoses and videos on other dermatological diseases. No significant differences were found between cosmetic dermatology and acne (p=.2392), between cosmetic dermatology and other facial dermatoses (p=.5493), and between acne and other facial dermatoses (p=.1266).

Table 9. Types of videos: Testing for significant differences.

	Videos (101)	**Views per video since uploaded**		**Average daily views per video since uploaded**	
Type of video		Mean	SD	Mean	SD
Cosmetic dermatology	51	61,639.94	71,612.31	255.49	32.54
Medical dermatology	50	46,627.06	44,008.43	181.06	173.69
Acne	21	70,828.95	50,304.45	268.66	201.94
Other facial dermatoses (excluding acne)	11	49,641.82	30,999.87	160.18	115.60
Other dermatological diseases	18	16,549.17	18,779.03	91.61	113.51
Testing for significant differences					
t-test			***t***	**d.f.**	***p*-value**
Cosmetic dermatology vs. Medical dermatology			-1.4467	77.355	.1511
Kruskal-Wallis rank test			**chi-sq.**	**d.f.**	***p*-value**
Four groups (cosmetic dermatology, acne, other facial dermatoses excluding acne, other dermatological diseases)			13.884	3	.0031**
Cosmetic vs. Acne			1.385	1	.2392
Cosmetic vs. Other facial dermatoses			.359	1	.5493
Cosmetic vs. Other dermatological diseases			8.956	1	.0028**
Acne vs. Other facial dermatoses			2.333	1	.1266
Acne vs. Other dermatological diseases			12.007	1	.0005**
Other facial dermatoses vs. Other dermatological diseases			37.375	1	.0533

Notes: Period: 25 October 2019–25 October 202. SD: Standard deviation; *t*-test: Two-sample *t*-test with unequal variances; d.f.: degrees of freedom.

While this research focuses on comparing average daily views of videos, other engagement analytics may add information about the qualitative perceptions of the public on a YouTube channel conducted by a dermatologist. The two-year period considered led to 221,993 likes, 47,162 shares, and 17,815 comments. To evaluate the degree of goodness of these channel analytics we used a study that considered 104,899 YouTube accounts and classified them as poor, average and good (www.marketingcharts.com , 2022).. Metrics that scored at the 60th percentile or higher were considered to be good. Specifically, the study considered the following engagement analytics:

(1) Like to dislike rate (i.e., percentage of number of likes over the sum of likes and dislikes);
(2) Views to subscriber ratio (i.e., number of views over number of subscribers);
(3) Comments to view rate (i.e., percentage of users who have watched the video who commented the video); and
(4) Likes to view rate (i.e., percentage of users who have watched the video who explicitly stated that they liked the video).

When these metrics were applied to the channel, we observed that the channel was above the threshold level required to be considered good in all of them. Firstly, like to dislike rate was 98.6% (>97.4%). Secondly, views to subscriber ratio was 41.01 (>33.1). Thirdly, comments to view rate was .32% (>.04%). Lastly, like to view rate was 4.03 (>3.72). Most comments were highly positive. Many users recognized the value of the knowledge conveyed through the channel and were highly appreciative that a dermatologist offered evidence-based knowledge on social media.

6.3 Factors that affect audience retention

The second experiment of this thesis, conducted with the aim of determining which factors influence audience retention in dermatological videos, led to the following results.

Step 1: Explanatory factors of average audience retention

The data involved 137 educational videos published over a period of 2 years and 9 months. The videos achieved 9,821,927 views, 394,086 likes, 25,857 comments and 88,964 shares.

The average audience retention of the 137 videos analysed was 41.69% (SD = 11.51), ranging from 23.03% to 147.69%. Although rare, audience retention may be higher than 100% when viewers watch some parts of the video several times before abandoning the video. The outlier video with the highest audience retention was the shortest one of the channel; it provided advice on how to optimise the absorption of topical vitamin C.

Table 10. Descriptive statistics of videos

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Audience retention	137	41.6983	11.5098	23.03	147.69
Days	137	469.67	271.92	4	942
Comments	137	188.73	157.03	4	940
Likes	137	2876.54	2940.84	72	19597
Dislikes	137	37.21	52.79	-40	486
Shared	137	649.37	763.89	14	4708
Length	137	13.23	5.37	.25	30.45
Views	137	71692.9	85653.65	1297	673601
Subscribers gained	137	1360.42	2273.55	2	17688

The average video length was 13.24 minutes (SD = 5.38). It ranged from .25 to 30.45 minutes, with the average video length on YouTube being 11.7 minutes.

Each video achieved 71,692.9 views on average (SD = 85,653.65). Overall, the videos achieved relatively high levels of engagement in terms of comments (m = 188.74), likes (m = 2876.54), and shares (m = 2940.84).

The preliminary analysis of the correlations between the variables showed that video length had the strongest negative correlation with average audience retention ($r = -.5790$; $p<.0001$) (Table 11).

Table 11. Correlations between average audience retention and related indicators

	Audience Retention	Days	Comments	Likes	Dislikes	Shares	Length	Views	Subscribers
Days	.0019	1							
p-value	*.9824*								
Comments	-.1788*	.1598	1						
p-value	*.0365*	*.0622*							
Likes	-.2041*	.0822	.8578*	1					
p-value	*.0167*	*.3393*	*<.0001*						
Dislikes	-.1984*	.0916	.5935*	.8312*	1				
p-value	*.0201*	*.2872*	*<.0001*	*<.0001*					
Shares	-.1771*	.1378	.8805*	.9372*	.7234*	1			
p-value	*.0384*	*.1083*	*<.0001*	*<.0001*	*<.0001*				
Length	-.5790*	-.3799*	.1865*	.2459*	.1610	.2053*	1		
p-value	*<.0001*	*<.0001*	*.0291*	*.0038*	*.0602*	*.0161*			
Views	-.2092*	.1834*	.8070*	.9603*	.8970*	.8789*	.1591	1	
p-value	*.0142*	*.0320*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*.0633*		
Subscribers gained	-.2135*	.1669	.8314*	.9289*	.7748*	.9097*	.2336*	.8985*	1
p-value	*.0122*	*.0513*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*.0060*	*<.0001*	

Notes: Days = Days since video release; Comments = Number of comments; Shares = Number of videos passed along to their friends by viewers; Length = video length; Subscribers = new subscribers gained with the video; Impressions = Number of times YouTube shows the video to the public; * Significant at 5% level.

Audience retention was negatively and significantly associated with most video success indicators (Table 11), such as views ($r = -.2092$; $p = .0142$), subscribers gained ($r = -.2135$; $p = .0122$), comments ($r = -.1788$; $p = .0365$), likes ($r = -.2041$; $p = .0167$) and shares ($r = -.1771$; $p = .0384$).

Multiple linear regression was used to identify possible predictors of average audience retention (see Regression 1, Table 12).

Only two predictors, video length and days from release, had a negative and significant effect on audience retention, with the effect of video length ($\beta = -.6979$; $p<.0001$) being strong and that of days from release being weak ($\beta = -.1948$; $p = 0.02$). The non-influence of views and engagement indicators (i.e. likes, comments and video shares) could be potentially due to the high correlation between these variables (i.e. multicollinearity; see Table 11). To control for the possible influence of multicollinearity, two multiple linear regressions were conducted, in which only an indicator of video popularity was included. Regression 2 (Table 12) included the number of views as a predictor, along with days from release and length. Regression 3 (Table 12) excluded views and included likes. Neither views nor likes were found to have a significant effect on audience retention. Finally, a forward stepwise linear regression (Regression 4, Table 12) was used to identify possible predictors of average audience retention out of all candidate variables. At each step, variables were added based on p-values, and a p-value threshold of .10 was used to set a limit on the total number of variables included in the final model. Only video length and days from release had a significant (and negative) effect on audience retention, which confirmed the findings of previous regressions.

Table 12. Explanatory factors of audience retention

	Reg. 1		**Reg. 2**		**Reg. 3**		**Reg. 4: Stepwise reg.**	
	Coefficient	P>|t|	Coefficient	P>|t|	Coefficient	P>|t|	Coefficient	P>|t|
Days	-.1948	.023*	-.2375*	.002*	-.2509*	.001*	-.2548	<.0001*
Comments	-.053482	.739				.851		
Likes	.6070	.135			-.0134			
Dislikes	-.0046	.980						
Shares	-.0131	.955						
Length	-.6979	<.0001*	-.0606*	<.0001*	-.6697*	<.0001*	-.6757	.001*
Views	-.6100	.100	-.6595	.394				
Subscribers	.0261	.896						
constant	65.110	<.0001*	65.686	<.0001*	65.908	<.0001*	65.904	<.0001*
Number of observations	137		137		137		137	
F	11.33		28.84		28.48		42.98	
Prob > F	.0000		<.0001*		<.0001*		<.0001*	
R-squared	.4147		.3941		.3911		.3908	
Adj R-squared	.3781		.3805		.3774		.3817	
Root MSE	9.076		9.059		9.083		9.050	

Notes: *Significant at 5% level.

Step 2: In-depth analysis of spikes

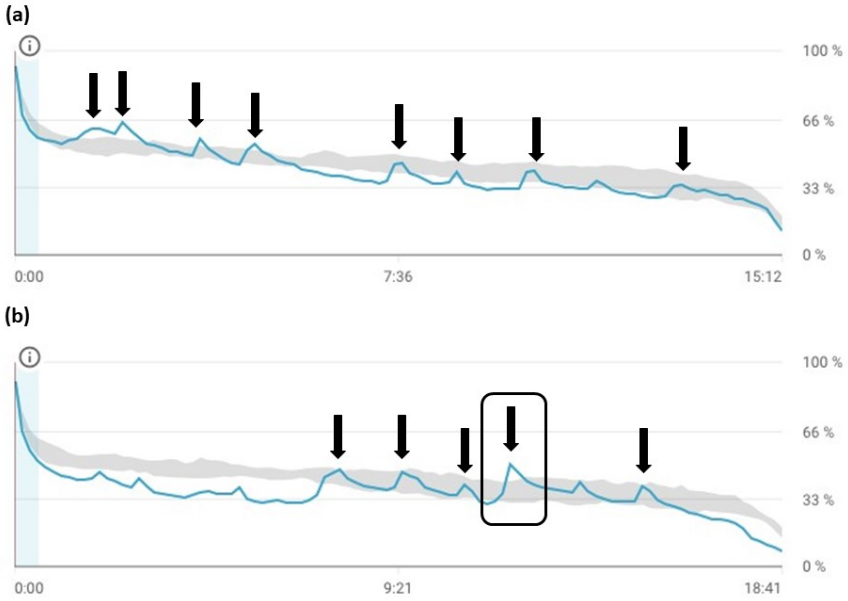
Spikes were observed in 76 videos (55.47%), and the total number of spikes was 157 (see Table 13). The average number of spikes per video was 2.07, and the spike number ranged from 1 to 8. The video with the most spikes was a video about skincare for acne and rosacea (Figure 12a). The mean upward change in the graph was 7.16%, and it ranged from 5% to 17%. The highest increase occurred in a video about sun protection for acne-prone skin (Figure 12b).

Table 13. Descriptive statistics of spikes

Spikes Yes/No	**Number of videos**
Yes	76
No	61
Spike number per video	**Number of videos**
1	36
2	18
3	12
4	5
5	3
6	1
8	1
Spikes (Total)	157
Average upward change in AR graph	7.16

Notes: AR = Audience retention.

Figure 12. Audience retention graphs of the videos with (a) the highest number of spikes and (b) the spike with the greatest audience retention increase.



Notes: (a) is a video about skincare for acne and rosacea that has 8 spikes (arrows), with a maximum increase of 10%. It has 79,843 views and an average retention rate of 35.8%; (b) is a video about sun protection for acne-prone skin. It has 5 spikes (arrows), with an increase of 17% (rectangle) in the fourth one. It has 328,644 views and an average retention rate of 30%.

Among the 157 spikes encountered, 107 (68.15%) were classified as procedural, 33 (21.01%) as conceptual and 17 (10.83%) as transitional. These results indicate that the parts of the videos that viewers found particularly interesting were mostly procedural. Examples of the content found in the spikes are shown in Table 14.

Table 14. Content in spikes

Category	Number of spikes	Percentage	Examples
Procedural	107	68.15	• Practical tips on how to use benzoyl peroxide to treat acne. • Features to look for in a facial cleanser. • How to prevent folliculitis. • What skincare to use after a medical peeling. • What concentration of retinol to use. • Commercial product options considered good for specific skin conditions.

			• How and in which order to combine vitamin C and niacinamide. • How to use fake tan. • The correct way to perform facial cleansing. • How to choose evidence-based nutritional supplements for acne.
Conceptual	33	21.01	• Causes of hyperpigmentation. • The physiopathology of acne. • The evolution of vitiligo. • How cosmetic actives for acne treatment work. • What physical sunscreen filters are. • Cosmetic actives that cannot be used during pregnancy. • How antibiotics work in acne. • The link between acne and diet. • Explaining whether laser hair removal is lifelong, and why. • Types of lasers that are effective for hair removal, and why.
Transition	17	10.83	• After logo or introduction of the channel. • In a video explaining treatment options for different types of acne scars, changing from speaking about hyperpigmented scars to speaking about atrophic scars. • In a video about different types of natural cosmetics, changing from speaking about aloe vera to speaking about castor oil. • In a video about hyaluronic acid, changing from speaking about topical hyaluronic acid to speaking about injected hyaluronic acid.
Total	157	100	

PART II
PUBLISHED MANUSCRIPTS

1

Benefits, drawbacks, and challenges of social media use in dermatology: A systematic review

Reference:
Barrutia L, Vega-Gutiérrez J, Santamarina-Albertos A. Benefits, drawbacks, and challenges of social media use in dermatology: a systematic review. *J Dermatolog Treat*. 2022;33(6):2738-2757. **doi:10.1080/09546634.2022.2069661**

2

What do patients want to see on social media? Evidence from a two-year experiment

Reference:
Barrutia L, Vega-Gutiérrez J, Santamarina-Albertos A. What do Patients Want to See on Social Media? Evidence From a Two-Year Experiment. *Dermatol Pract Concept.* 2023;13(1):e2023020. Published 2023 Jan 1. **doi:10.5826/dpc.1301a20**

3

Audience retention on educational dermatological videos: An exploratory study using a dermatologist-led experimental YouTube channel

Reference:
Barrutia L, Vega-Gutiérrez J, Santamarina-Albertos A. Audience retention on educational dermatological videos: An exploratory study using a dermatologist-led experimental YouTube channel [published online ahead of print, 2023 Mar 10]. Clin Exp Dermatol. 2023;llad090. **doi:10.1093/ced/llad090**

PART III
CONCLUSIONS

1. Discussion and conclusions

This section discusses how the results of the thesis add to the existing body of knowledge and shed light on previously unexplored areas. The discussion also extends to the practical implications of the findings, emphasizing their impact and potential influence in decision-making processes. Lastly, this section outlines directions for future research based on the limitations identified in the present work.

1.1 Theoretical contribution and practical implications

The three publications that comprise this thesis, namely, "*Benefits, drawbacks, and challenges of social media use in dermatology: a systematic review*" (see Part II, Section 1), "*What do patients want to see on social media? Evidence from a two-year experiment*" (see Part II, Section 2) and "*Audience retention on educational dermatological videos: An exploratory study using a dermatologist-led experimental YouTube channel*" (see Part II, Section 3) have provided answers to gaps identified in the previous literature, and have provided practical resources to optimize health promotion performed by dermatologists on social media platforms.

The research article "*Benefits, drawbacks, and challenges of social media use in dermatology: a systematic review*" (see Part II, Section 1) was conceived because the previous literature had led to a crossroads, where the many advantages of social media use in dermatology seemed to be underestimated due to the presence of potential drawbacks. The previous studies performed in this setting had not provided a global overview of the repercussions of the presence of dermatologists on these networks. This article brought together and discussed all the benefits, drawbacks and challenges previously mentioned. It provided clear evidence that the benefits derived from the presence of dermatologists on social media are numerous, and that risks are scarce when applying the same ethical standards as in traditional settings. It grouped all the drawbacks and challenges that social media platforms comprise for dermatologists, and it provided practical strategies to counteract them. It supported that dermatologists should not fear social media but rather feel a responsibility to educate patients by using high scientific standards and acting as leaders in the online world of skin health. It showed that dermatologists should focus on improving aspects found to be

lacking by previous studies, such as providing references to the sources of information used. At the same time, it underlined that dermatologists should also aim to create engaging content to ensure visibility. Additionally, it found that the responsible use of social media by physicians can also have multiple other benefits, such as understanding patients better, generating new scientific findings, sharing difficult cases among professionals across the world and comparing approaches and protocols globally, leading to greatly improved patient care.

The research article "*What do patients want to see on social media? Evidence from a two-year experiment*" (see Part II, Section 2) showed that public concerns focus on acne and cosmetic dermatology, and that viewers are not equally interested in all dermatological topics. Therefore, it provided evidence that it might be difficult to become successful on social media and ensure visibility while presenting a balanced portrayal of our specialty. It highlighted how this represents an important challenge for dermatologists, because some topics, despite being less popular, need to be addressed due to their importance, such as skin cancer and its prevention. Consequently, this study underlined that dermatologists face the difficult challenge of finding a balance between prioritizing popular topics and not disregarding others that may have an important impact on people's wellbeing. No previous contributions have been made previously to support this controversy, discussed in previous studies only from a conceptual point of view.

While keeping this balance in mind, this study showed that prioritizing the topics that people want to see (i.e., acne and cosmetic dermatology) can have the next three benefits for dermatologists and society as a whole: (1) ensuring visibility, (2) having a positive, evidence-based influence on dermatological culture and health-related decisions, and (3) having a real option to convey a complete portrayal of dermatological topics (albeit with unequal prominence).

Firstly, it showed how, to ensure visibility, YouTube videos must be promoted by the YouTube algorithm. While the operation of the algorithm is a black box, it seems to favour content that is viewed more frequently by users (i.e., what users, through their behaviour, have revealed they want to see). This mechanism makes it extremely difficult to attain public influence while presenting topics that the public does not usually search for on YouTube.

Secondly, it found that focusing on what people want to see provides dermatologists a real opportunity to have a positive, evidence-based influence on people's culture and behaviour. It provided comments on videos about popular topics that illustrate how they can help foster important dermatological culture that extends beyond the focal topic, such as: "*Since watching your videos, I use sunscreen regularly*." In particular, it found that focusing on acne can lead to increased visibility among adolescents. This can facilitate dissemination of important dermatological habits such as sun protection from a young age, aiding in skin cancer prevention. Therefore, it underlined how focusing on popular topics can be a way of conveying messages about other important dermatological issues. It remarked that dermatologists can create content about topics that concern users and use it to convey additional skin health advice in a way that is compelling to listeners.

Thirdly, it showed that focusing on people's interests serves to gain subscribers and build loyalty. Loyal subscribers tend to watch more channel videos, including those on less frequently searched dermatological content. It provided some video comments that are illustrative of this, such as: "*I watch all your videos*," "*I do not have vitiligo, but the video is interesting*." Therefore, it found that these less popular videos receive more views than they would otherwise, which increases the likelihood that the YouTube algorithm will promote them to other users. Hence, it reached the conclusion that focusing on popular topics can, in the end, facilitate dissemination of accurate knowledge about the broad spectrum of dermatology.

The results of the study showed an overall preference for topics related to facial dermatological issues. What acne, cosmetic dermatology and other facial dermatoses have in common is that they affect the face. Views on videos about these topics are significantly higher than those on videos about dermatological diseases that do not normally affect this body area, such as psoriasis, hyperhidrosis or hidradenitis suppurativa. Because the face is the most visible body part, previous studies have found that skin diseases on this area can have a remarkable effect on patients' self-esteem and a profound negative impact on quality of life. As a consequence, it seems logical that users search for these topics more than for less noticeable dermatological diseases.

Previous literature had already suggested, regarding other aspects of social media content, that dermatologists should adapt their content to the population. For instance, Güder and Güder (2022) focused on the language used. They highlighted that, to increase visibility, dermatologists should use words that patients use, instead of technical terms. This second

article of the thesis adds that focusing on popular topics can be a successful strategy that follows a similar approach.

In conclusion, it found that, while dermatologists must share information on important topics, such as skin cancer, even at the expense of losing visibility, prioritizing the goal of conveying a balanced portray of dermatology is difficult to achieve in the real social media world. It highlighted that the rationality behind this finding is that meeting this goal implies trying to lead social media users to focus their attention on topics in which they have no interest. It provided the idea that breaking this balance in favour of popular content, without completely neglecting other relevant dermatological topics, might be worth it for dermatologists to accomplish a very relevant social mission.

The research article "*Audience retention on educational dermatological videos: An exploratory study using a dermatologist-led experimental YouTube channel*" (see Part II, Section 3) was conceived from the premise that, while dermatologists have great potential to improve the quality of life of the public by creating evidence-based YouTube videos, this also represents a great challenge. Its aim was to provide dermatologists with insights into how to design their videos to increase audience retention.

No previous studies had analysed audience retention in dermatologist-led channels. Therefore, there were no clear benchmarks for evaluating it. As a preliminary reference, in this study, the results obtained were compared with research from professional sources, which had revealed that typical retention rates range from 30% to 40%.22,23 Within the area of medical education, results were compared to those contributed by Lau et al. (2018), who developed an online course that included video-based lectures. The average audience retention obtained by these authors was 41%. However, they removed viewers who abandoned the video in the first 30 seconds, which means that, according to YouTube calculations, audience retention would have been lower. In a study published by Zaila et al. (2020) about educational YouTube videos in the field of urology, audience retention ranged from 9% to 22%.25 Therefore, this study added a benchmark or reference within dermatology and contributed that the audience retention in the dermatological channels can be relatively high (41.69% in the focal channel).

An interesting finding of this study was that audience retention increases as video length is reduced. This finding leads to the recommendation of minimising redundancy.

Dermatologists should analyse videos from the users' perspectives and remove all content that they perceive as valueless.

Another interesting finding of this study was that audience retention of new videos on the same channel can decrease. While, according to the data, the influence of this variable on audience retention is weak, it seems that when a channel is new, it reaches a few users but highly motivated ones, whereas when the channel grows, it also reaches less motivated users. Another explanation could be that viewers might experience a learning effect. In particular, subscribers could learn to skip some parts that do not interest them (e.g. when the dermatologist delves into technical details) or aspects that have already been discussed in previous videos.

Additionally, a thought-provoking finding of this study wass that the audience is essentially interested in acquiring practical knowledge. More than two-thirds of the spikes observed in the videos corresponded to procedural knowledge focused on how to solve different skincare-related problems. Seemingly, viewers mainly watch the videos to find solutions for their concerns. A solution can be an explanation of how to apply a treatment or advice for after having a procedure performed. The public does not seem to be as interested in understanding the science that supports this practical advice. While it is clear that conceptual content cannot be completely removed from a dermatological video, these results suggest that dermatologists should try to make it concise and focus on conveying scientifically accurate practical information. Additionally, dermatologists should provide references so that further interested viewers can deepen their knowledge, and remind viewers that YouTube videos should not replace in-person or telemedicine consultations with a board-certified dermatologist.

Taken together, the findings of these study indicate that, to increase audience retention, dermatologists should design videos that are succinct and deliver procedural knowledge that the public perceives as valuable. This contribution is important because the potential benefits of dermatologists' presence on social media can only be realised if their content becomes popular.

1.2 Limitations and further research

As with any research project, there are limitations to this thesis that should be taken into account. These limitations may have affected the studies' results and should be considered when interpreting the research outcomes presented in this thesis. This section covers the limitations of the research methods, specifically the analysis of a single dermatological channel in the experiments performed. More research is needed to overcome these limitations and shed light on the additional questions raised by our findings.

The experimental part of this thesis analyzes a single dermatological channel, which implies that it adopts the so-called 'ego network approach' by studying a unique network. This approach has the advantage of providing in-depth knowledge, but it does not lead to generalizable results. However, it is the first study about dermatology on social media that uses a primary source. While performing research from primary sources is the tradition of scientific research in dermatology, in the case of social media, previous contributions rely on secondary sources and conceptual developments. The reason behind this is that, to obtain data from primary sources, a presence with visibility must be developed on social media, with the difficulties and challenges that this implies. Future research should focus on developing this type of social media presence and contributing data to the literature, to be able to reach broader conclusions.

Additionally, while the second study of this thesis, namely "*What do patients want to see on social media? Evidence from a two-year experiment*" (see Part II, Section 2) shed light on the thematic preferences of the population by analysing video views, further research could focus on gaining additional insight into the profiles of patients who perform online searches and on analyzing user-generated content, such as comments. This could potentially shed light on the public's true opinions on specific social media content and, therefore, help in finding strategies to create successful content. Further research could also involve initiatives to educate patients on distinguishing between high-quality and low-quality content and to allow researchers to evaluate the true impact of social media-based health promotion campaigns.

Intriguingly, the third study of these thesis, namely: "*Audience retention on educational dermatological videos: An exploratory study using a dermatologist-led experimental YouTube*

channel" (see Part II, Section 3) found that audience retention was negatively and significantly associated with most video success-related indicators. While this finding could be considered counterintuitive, when a video has relatively few views, it is mostly watched by channel subscribers and people who have specifically searched for the particular characteristics of the video. It is likely that these people are highly motivated to watch the whole video or a large part of it. In contrast, when the video has a relatively large number of views, it is more likely to attract viewers who may have only a marginal interest in the video, leading to lower audience retention. However, the series of multiple linear regressions conducted did not confirm this effect. Further research is needed in this field.

2. List of publications and quality indicators

Article	Journal	Quality indicators	Reference	Status
Benefits, drawbacks, and challenges of social media use in dermatology: A systematic review	Journal of Dermatological Treatment	Journal Citation Reports Impact Factor: 3.230 Dermatology 26/69, Q2	Barrutia L, Vega-Gutiérrez J, Santamarina-Albertos A. Benefits, drawbacks, and challenges of social media use in dermatology: a systematic review. J Dermatolog Treat. 2022;33(6):2738-2757. doi:10.1080/09546634.2022.2069661	Published
What do patients want to see on social media? Evidence from a two-year experiment	Dermatology Practical & Conceptual	Journal Citation Reports Impact Factor: 2.753 Dermatology 37/69, Q3	Barrutia L, Vega-Gutiérrez J, Santamarina-Albertos A. What do Patients Want to See on Social Media? Evidence From a Two-Year Experiment. Dermatol Pract Concept. 2023;13(1):e2023020. Published 2023 Jan 1. doi:10.5826/dpc.1301a20	Published
Audience retention on educational dermatological videos: An exploratory study using a dermatologist-led experimental YouTube channel	Clinical and Experimental Dermatology	Journal Citation Reports Impact Factor: 4.481 Dermatology 16/69, Q1	Barrutia L, Vega-Gutiérrez J, Santamarina-Albertos A. Audience retention on educational dermatological videos: An exploratory study using a dermatologist-led experimental YouTube channel [published online ahead of print, 2023 Mar 10]. Clin Exp Dermatol. 2023;llad090. doi:10.1093/ced/llad090	Published

PART IV
REFERENCES

1. Wu T, Simonetto DA, Halamka JD, Shah VH. The digital transformation of hepatology: The patient is logged in. Hepatology. 2022;75(3):724-739. doi:10.1002/hep.32329
2. Bhaskar S, Nurtazina A, Mittoo S, Banach M, Weissert R. Editorial: Telemedicine During and Beyond COVID-19. Front Public Health. 2021 Mar 16;9:662617. doi: 10.3389/fpubh.2021.662617. PMID: 33796502; PMCID: PMC8007781.
3. Althubaiti A, Tirksstani JM, Alsehaibany AA, Aljedani RS, Mutairii AM, Alghamdi NA. Digital transformation in medical education: Factors that influence readiness. Health Informatics J. 2022;28(1):14604582221075554. doi:10.1177/14604582221075554
4. Lattouf OM. Impact of digital transformation on the future of medical education and practice. J Card Surg. 2022;37(9):2799-2808. doi:10.1111/jocs.16642
5. Zheng DX, Mulligan KM, Scott JF. #DermTwitter anddigital mentorship in the COVID-19 era. J Am AcadDermatol. 2021;85:e17–e18.
6. De La Garza H, Maymone MBC, Vashi NA. Impact of social media on skin cancer prevention. IJERPH. 2021;18(9):5002.
7. Correia O, Duarte AF, Del Marmol V, et al. Euromelanoma in Portugal. How useful was the Euromelanoma campaign between 2010 and 2017? Int J Dermatol. 2018;57(10):e85–e88.
8. Gantenbein L, Navarini AA, Maul LV, et al. Internet andsocial media use in dermatology patients: Search behavior and impact on patient-physician relationship. Dermatol Ther. 2020;33(6):e14098.
9. George DD, Wainwright BD. Dermatology resources on the internet. Semin Cutan Med Surg. 2012;31(3):183–190.
10. Edosomwan, S., Prakasan, S. K., Kouame, D., Watson, J., & Seymour, T. (2011). The history of social media and its impact on business. Journal of Applied Management and entrepreneurship, 16(3), 79.
11. Garfan S, Alamoodi AH, Zaidan BB, et al. Telehealth utilization during the Covid-19 pandemic: A systematic review. Comput Biol Med. 2021;138:104878. doi:10.1016/j.compbiomed.2021.104878
12. Benabio J. The value of social media for dermatologists. Cutis. 2013;91(6):269-270.
13. Tankovska, H. Most popular social networks worldwide as of January 2021, ranked by number of active users. Statista. 2021. Available at: https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number- of-users/.

14. Taberner R. e-Dermatology: social networks and other web based tools. Actas Dermosifiliogr. 2016;107(2): 98–106.
15. DeBord LC, Patel V, Braun TL, et al. Social media in dermatology: clinical relevance, academic value, and trends across platforms. J Dermatolog Treat. 2019;30(5): 511–518.
16. Croley JAA. Emerging roles of social media in dermatology. Cutis 2019;103: E13-E14.
17. Carlquist E, Lee NE, Shalin SC, et al. Dermatopathology and Social Media: A Survey of 131 Medical Professionals From 29 Countries. Arch Pathol Lab Med 2018; 142:184-190.
18. Available at: www.statista.com Last accessed December 20, 2021.
19. Udey MC. Jumpstarting the Journal of Investigative Dermatology's Social Media Effort: Calling on Experts. J Invest Dermatol 2020; 140: 1882-1883.
20. Zheng DX, Ning AY, Levoska MA, et al. TikTok™, teens and isotretinoin: recommendations for identifying trending acne-related content on the world's most popular social media platform. Clin Exp Dermatol. 2021; 46: 1129-1130.
21. Sun HY, Sebaratnam DF. Medical dermatologists on social media: a call to action. J Am Acad Dermatol 2021; 84: e163-e164.
22. Janda M, Soyer HP. Using Mobile Health Technology and Social Media for the Prevention and Early Detection of Skin Cancer. Dermatology 2020; 236: 72-74.
23. Vasconcelos Silva C, Jayasinghe D, Janda M. What Can Twitter Tell Us about Skin Cancer Communication and Prevention on Social Media?. Dermatology 2020; 236: 81-89.
24. Guzman AK, Barbieri JS. Comment on 'Dermatologists in social media: A study on top influencers, posts, and user engagement' [published online ahead of print, 2020 Apr 20]. J Am Acad Dermatol 2020; S0190-9622(20)30675-7. https://doi.org/:10.1016/j.jaad.2020.03.118.
25. Young TK, Oza VS. Digital dermatoses: skin disorders engendered by social media in tweens and teens. Curr Opin Pediatr 2021; 33: 373-379.
26. Drozdowski R, Gronbeck C, Feng H. Mask-related acne in the COVID-19 pandemic: an analysis of Twitter posts and influencers. Clin Exp Dermatol 2021; 46: 943-945.
27. Wong XL, Liu RC, Sebaratnam DF. Evolving role of Instagram in #medicine. Intern Med J 2019; 49: 1329-1332.
28. Mueller SM, Jungo P, Cajacob L, et al. The Absence of Evidence is Evidence of Non-Sense: Cross-Sectional Study on the Quality of Psoriasis-Related Videos on YouTube

and Their Reception by Health Seekers. J Med Internet Res 2019; 21: e11935. Published 2019 Jan 16.

29. Gorrepati PL, Smith GP. DISCERN scores of YouTube information on eczema treatments. J Am Acad Dermatol 2021; 85: 1354-1355.
30. Iglesias-Puzas Á, Conde-Taboada A, Aranegui-Arteaga B, et al. 'Fake news' in dermatology. Results from an observational, cross-sectional study. Int J Dermatol 2021; 60: 358-362.
31. Chen AY, Azizi B, Borba AJ, et al. Rosacea videos on social media: A comparison of accuracy, quality, and viewer engagement. Dermatol Online J 2021; 27: 13030/qt55c0g9wz.
32. Ranpariya V, Chu B, Fathy R, et al. Instagram influencer definitions and the need for dermatologist engagement on social media. J Am Acad Dermatol 2020; 83: e449-e450.
33. Nikookam Y, Guckian J. TikTok™ and dermatology: lessons for medical education. Clin Exp Dermatol 2021; 46: 952-953.
34. Schoenberg E, Shalabi D, Wang JV, et al. Public social media consultations for dermatologic conditions: an online survey. Dermatol Online J 2020; 26: 13030/qt5ht4k2rh.
35. Orgaz-Molina J, Cotugno M, Girón-Prieto MS, et al. A study of Internet searches for medical information in dermatology patients: The patient-physician relationship. Actas Dermosifiliogr 2015; 106: 493-499.
36. Karimkhani C, Connett J, Boyers L, et al. Dermatology on instagram. Dermatol Online J 2014; 20: 13030/qt71g178w9. Published 2014 Jul 15.
37. Miller KA, Ramirez CN, Wojcik KY, et al. Prevalence and correlates of health information-seeking among Hispanic and non-Hispanic childhood cancer survivors. Support Care Cancer 2018; 26: 1305-1313.
38. Ross NA, Todd Q, Saedi N. Patient seeking behaviors and online personas: social media's role in cosmetic dermatology. Dermatol Surg 2015; 41: 269-276.
39. Sierro TJ, Young PM, Kassabian SK, et al. Dermatologists in social media: A study on top influencers, posts, and user engagement. J Am Acad Dermatol 2020; 83: 1452-1455.
40. Freitag CE, Arnold MA, Gardner JM, et al. If You Are Not on Social Media, Here's What You're Missing! #DoTheThing. Arch Pathol Lab Med 2017; 141: 1567-1576.
41. Travers RL. Social media in dermatology: moving to Web 2.0. Semin Cutan Med Surg 2012; 31: 168-173.

42. Wang JV, O'Donnell M, Albornoz CA, et al. Resident experiences with social media: modernizing dermatology training. Int J Dermatol 2018; 57: e169-e170.
43. Zhou J, Bercovitch L. Instagram and the dermatologist: An ethical analysis. J Am Acad Dermatol 2018; 78: 1226-1228.
44. Patel RR, Hill MK, Smith MK, et al. An updated assessment of social media usage by dermatology journals and organizations. Dermatol Online J 2018; 24: 13030/qt3jr646v0. Published 2018 Feb 15.
45. Boyers LN, Quest T, Karimkhani C, et al. Dermatology on YouTube. Dermatol Online J 2014; 20: 13030/qt5037g18h. Published 2014 Jun 15.
46. Lenczowski E, Dahiya M. Psoriasis and the Digital Landscape: YouTube as an Information Source for Patients and Medical Professionals. J Clin Aesthet Dermatol 2018; 11: 36-38.
47. Galadari HI. Social media and modern dermatology. Int J Dermatol 2018; 57: 110-111.
48. Mueller SM, Hongler VNS, Jungo P, et al. Fiction, Falsehoods, and Few Facts: Cross-Sectional Study on the Content-Related Quality of Atopic Eczema-Related Videos on YouTube. J Med Internet Res 2020; 22: e15599. Published 2020 Apr 24.
49. Pithadia DJ, Reynolds KA, Lee EB, et al. A cross-sectional study of YouTube videos as a source of patient information about phototherapy and excimer laser for psoriasis. J Dermatolog Treat 2020; 31: 707-710.
50. Freemyer B, Drozd B, Suarez A. A cross-sectional study of YouTube videos about atopic dermatitis. J Am Acad Dermatol 2018; 78: 612-613.
51. Fogel AL, Teng JM. Social Media Use in Pediatric Dermatology. Pediatr Dermatol 2016; 33: e131-e133.
52. Damude S, Hoekstra-Weebers JEHM, van Leeuwen BL, Hoekstra HJ. Melanoma patients' disease-specific knowledge, information preference, and appreciation of educational YouTube videos for self-inspection. Eur J Surg Oncol 2017; 43: 1528-1535.
53. Alex SE, Wong C, Shah A, et al. Social Media as a Surveillance Tool for Monitoring of Isotretinoin Adverse Effects. Cureus 2020; 12: e10327. Published 2020 Sep 9.
54. Wells TM, Rundle CW, Szeto MD, et al. An Analysis of Skin of Color Dermatology Related Content on Instagram. J Drugs Dermatol 2020; 19: 746-754.
55. Park JH, Christman MP, Linos E, et al. Dermatology on Instagram: An Analysis of Hashtags. J Drugs Dermatol 2018; 17: 482-484.

56. Oltulu P, Fındık S, Özer İ. The usage of social media tools in dermatology and dermatopathology: A new generation vocational communication and education method. Türk dermatoloji dergisi 2018; 12: 80-84.
57. Presley CL, Pulsipher KJ, Rietcheck HR, et al. Reply to 'Dermatologists in social media: A study on top influencers, posts, and user engagement': Dermatologist influencers on TikTok [published online ahead of print, 2021 Feb 2]. J Am Acad Dermatol 2021; S0190-9622(21)00250-4. https://doi.org/10.1016/j.jaad.2021.01.090
58. Sierro TJ, Young PM, Kassabian SK, et al. Response to Letter to the Editor 'Reply to 'Dermatologists in Social Media: A Study on Top Influencers, Posts, and User Engagement': Dermatologist Influencers on TikTok' [published online ahead of print, 2021 Jan 30]. J Am Acad Dermatol 2021; S0190-9622(21)00249-8. https://doi.org/10.1016/j.jaad.2021.01.089.
59. Payette MJ, Albreski D, Grant-Kels JM. 'You'd know if you 'friended' me on Facebook': legal, moral, and ethical considerations of online social media. J Am Acad Dermatol 2013; 69: 305-307.
60. Iglesias-Puzas Á, Conde-Taboada A, Aranegui-Arteaga B, et al. Understanding the role of social media to support patients with mastocytosis: Content analysis of Facebook communities. Australas J Dermatol 2021; 62: e292-e294.
61. Amir M, Sampson BP, Endly D, et al. Social networking sites: emerging and essential tools for communication in dermatology. JAMA Dermatol 2014; 150: 56-60.
62. Blumenthal KG, Topaz M, Zhou L, et al. Mining social media data to assess the risk of skin and soft tissue infections from allergen immunotherapy. J Allergy Clin Immunol. 2019;144(1):129-134. doi:10.1016/j.jaci.2019.01.029
63. Daneshjou R, Adamson AS. Twitter Journal Clubs: Medical Education in the Era of Social Media. JAMA Dermatol 2020; 156: 729-730.
64. Wehner MR, Chren MM, Shive ML, et al. Twitter: an opportunity for public health campaigns. Lancet 2014; 384: 131-132.
65. Falzone AE, Brindis CD, Chren MM, et al. Teens, Tweets, and Tanning Beds: Rethinking the Use of Social Media for Skin Cancer Prevention. Am J Prev Med 2017; 53: S86-S94.
66. Stekelenburg N, Horsham C, O'Hara M, et al. Using Social Media to Determine the Affective and Cognitive Components of Tweets about Sunburn. Dermatology 2020; 236: 75-80.

67. Sugawara Y, Narimatsu H, Tsuya A, et al. Medical Institutions and Twitter: A Novel Tool for Public Communication in Japan. JMIR Public Health Surveill 2016; 2: e4831.
68. Sarker A, Magge A, Sharma A. Dermatologic concerns communicated through Twitter. Int J Dermatol 2017; 56: e162-e163.
69. Okon E, Rachakonda V, Hong HJ, et al. Natural language processing of Reddit data to evaluate dermatology patient experiences and therapeutics. J Am Acad Dermatol 2020; 83: 803-808.
70. Buntinx-Krieg T, Caravaglio J, Domozych R, et al. Dermatology on Reddit: elucidating trends in dermatologic communications on the world wide web. Dermatol Online J 2017; 23: 2. 13030/qt9dr1f7x6. Published 2017 Jul 15.
71. Chu B, Fathy R, Nobles AL, et al. Patient crowdsourcing of dermatologic consults on a Reddit social media community. J Am Acad Dermatol 2021; 85: 226-227.
72. Correnti C, Boyers L, Karimkhani C, et al. Dermatology on Tumblr. Dermatol Online J 2014; 20: 22642. Published 2014 May 16.
73. Whitsitt J, Mattis D, Hernandez M, et al. Dermatology on pinterest. Dermatol Online J 2015; 21: 13030/qt7dj4267p. Published 2015 Jan 15.
74. Patel RR, Yazd NKK, Dellavalle RP. Dermatology on Snapchat. Dermatol Online J 2017; 23: 13030/qt1br5c7s2. Published 2017 Jul 15.
75. Tan A, Gutierrez D, Milam EC, et al. Patient health-seeking behavior on WeChat: Social media and dermatology. JAAD Case Rep 2020; 6: 136-138. Published 2020 Jan 27.
76. Hill MK, Patel RR, Anand P, et al. Dermatology on Google. Dermatol Online J 2018; 24: 13030/qt6cz3q82h. Published 2018 Apr 15.
77. Kuschel S, Patel RR, Dellavalle RP. Dermatology on Flickr. Dermatol Online J 2018; 24: 13030/qt3cf3n1mc. Published 2018 Oct 15.
78. Ashack KA, Burton KA, Dellavalle RP. Dermatology in Doximity. Dermatol Online J 2016; 22: 13030/qt2r79s88k. Published 2016 Feb 17.
79. Nickles MA, Rustad AM, Ogbuefi N, et al. What's being recommended to patients on social media? A cross-sectional analysis of acne treatments on YouTube. J Am Acad Dermatol 2022; 86(4):920–3. doi:10.1016/j.jaad.2021.03.053
80. Killion L, Therianou A, Watchorn RE. What's being recommended to patients on social media? A cross-sectional analysis of alopecia treatments on YouTube®. Clin Exp Dermatol 2022; 47(4):759–63. doi:10.1111/ced.15030

81. Guo PJ, Kim J, Rubin R. How video production affects student engagement: an empirical study of MOOC videos. In Proceedings of the first ACM conference on Learning@ scale conference (pp. 41-50), 2014.
82. Gupta AK, Ivanova IA. Analysis of YouTube hair loss treat-ment information: what makes for engaging content?Dermatol Ther. 2020;33(6):e14244.
83. Zheng DX, Ning AY, Levoska MA, Xiang L, Wong C, Scott JF. Acne and social media: A cross-sectional study of content quality on TikTok. Pediatr Dermatol. 2021;38(1):336-338. doi:10.1111/pde.14471
84. Reuter K, Lee D. Perspectives Toward Seeking Treatment Among Patients With Psoriasis: Protocol for a Twitter Content Analysis. JMIR Res Protoc. 2021; 10: e13731. Published 2021 Feb 18.
85. Long V, Tan CL, Choi EC. What's #Trending: embracing social media in dermatology. Int J Dermatol 2022; 61: e44-e46
86. Rafferty S, O'Connor C, Murphy M. 'Fake News'-5G mobile phones and skin cancer: A global analysis of concerns on social media. Skin Res Technol 2021; 27: 113.
87. Roche L, Nic Dhonncha E, Murphy M. TikTok™ and dermatology: promises and pearls. Clin Exp Dermatol 2021; 46: 737-739.
88. Reddy PS, DeBord LC, Gupta R, et al. Antibiotics for acne vulgaris: using instagram to seek insight into the patient perspective. J Dermatolog Treat 2021; 32: 188-192.
89. Reynolds KA, Pithadia DJ, Lee EB, et al. YouTube videos on oral systemic therapies for psoriasis: a cross-sectional analysis. J Dermatolog Treat 2019; 30: 549.
90. Breves, PL, Liebers N, Kunze A. The perceived fit between Instagram influencers and the endorsed brand: How influencer–brand fit affects source credibility and persuasive effectiveness. J Mark Res 2019; 59(4): 440-454.
91. Casaló LV, Flavián C, Ibáñez-Sánchez S. Influencers on Instagram: Antecedents and consequences of opinion leadership. J Bus Res 2020; 117, 510-519.
92. Chaiken S. Heuristic versus systematic information processing and the use of source versus message cues in persuasion. J Pers Soc Psychol 1980; 39(5): 752–766.
93. Chaiken S, Maheswaran D. Heuristic processing can bias systematic processing: Effects of source credibility, argument ambiguity, and task importance on attitude judgment. J Pers Soc Psychol 1994; 66(3): 460–473.
94. Cialdini, RB. We have to break up. Perspect Psychol Sci 2009; 4(1): 5-6.
95. Ki C, Kim YK. The mechanism by which social media influencers persuade consumers: The role of consumers' desire to mimic. Psychol Mark 2019; 36(10), 905-922.

96. Masuda H, Han SH, Lee J. Impacts of influencer attributes on purchase intentions in social media influencer marketing: Mediating roles of characterizations. Technol Forecast Soc Change 2022; 174: 121246.
97. Petty RE, Cacioppo, JT. The elaboration likelihood model of persuasion. Adv Exp Soc Psychol 1986; 19: 123–162.
98. Petty RE, Cacioppo JT, Goldman R. Personal involvement as a determinant of argument-based persuasion. J Pers Soc Psychol 1981; 41(5): 847–855.
99. Trivedi J, Sama R. The Effect of Influencer Marketing on Consumers' Brand Admiration and Online Purchase Intentions: An Emerging Market Perspective. J Internet Commer 2020; 19(1): 103-124.
100. Xiao M, Wang R, Chan-Olmsted, S. Factors affecting YouTube influencer marketing credibility: a heuristic-systematic model. J Media Bus Stud 2018; 15(3): 188-213.
101. Croes, Emmelyn, and Jos Bartels. "Young adults' motivations for following social influencers and their relationship to identification and buying behavior." Comput Hum Behav 2021; 124: 106910.
102. MarketingCharts. YouTube Influencer Engagement Rate Benchmarks: What Are Good Rates? Available at: https://www.marketingcharts.com/digital/video-112775#:~:text=Per%20the%20report%2C%20metrics%20that,considered%20to%20have%20good%20performance. Last accessed 15 February 2022.
103. Morrison L, Chen C, Torres JS, et al. Facebook advertising for cancer prevention: a pilot study. Br J Dermatol 2019; 181: 858-859.
104. Klietz ML, Kaiser HW, Machens HG, et al. Social Media Marketing: What Do Prospective Patients Want to See? Aesthet Surg J 2020; 40: 577-583.
105. Orion E, Wolf R. Psychologic consequences of facial dermatoses. Clin Dermatol. 2014;32(6):767-771. doi:10.1016/j.clindermatol.2014.02.016.
106. Kouris A, Platsidaki E, Christodoulou C, et al. Patients' self-esteem before and after chemical peeling procedure. J Cosmet Laser Ther. 2018;20(4):220-222. doi:10.1080/14764172.2017.1400168
107. van Zuuren EJ, Arents BWM, van der Linden MMD, Vermeulen S, Fedorowicz Z, Tan J. Rosacea: New Concepts in Classification and Treatment. Am J Clin Dermatol. 2021;22(4):457-465. doi:10.1007/s40257-021-00595-7.

108. Yousaf A, Hagen R, Delaney E, Davis S, Zinn Z. The influence of social media on acne treatment: A cross-sectional survey. Pediatr Dermatol. 2020;37(2):301-304. doi:10.1111/pde.14091

109. Krathwohl DR. A revision of Bloom's taxonomy: An overview. Theory Pract 2002; 41(4):212–8.

110. Albeshri M, Alharithy R, Altalhab S, et al. The Influence of Modern Social Media on Dermatologist Selection by Patients. Cureus 2020; 12: e11822. Published 2020 Dec 1.

111. Murphy EC, Nelson K, Friedman AJ. The Influence of Dermatologists' Use of Social Media on Attracting Patients. J Drugs Dermatol 2020; 19: 532-538.

112. Nguyen JL, Heckman C, Perna F. Analysis of the Twitter 'Don't Fry Day' Campaign. JAMA Dermatol 2018; 154: 961-962.

113. Sarkar U, Le GM, Lyles CR, et al. Using Social Media to Target Cancer Prevention in Young Adults: Viewpoint. J Med Internet Res 2018; 20: e203. Published 2018 Jun 5.

114. Endly DC, Sampson BP, Dellavalle RP. 'Like' us on Facebook: an evaluation of the JAAD's inaugural year on Facebook. J Am Acad Dermatol 2013; 68: 335-337.

115. Ricklefs CA, Asdigian NL, Kalra HL, et al. Indoor tanning promotions on social media in six US cities #UVTanning #tanning. Transl Behav Med 2016; 6: 260-270.

116. Cardwell LA, Nyckowski T, Uwakwe LN, et al. Coping Mechanisms and Resources for Patients Suffering from Rosacea. Dermatol Clin 2018; 36: 171-174.

117. Seidenberg AB, Pagoto SL, Vickey TA, et al. Tanning bed burns reported on Twitter: over 15,000 in 2013. Transl Behav Med 2016; 6: 271-276.

118. Kamath P, Kursewicz C, Ingrasci G, et al. Analysis of patient perceptions of Mohs surgery on social media platforms. Arch Dermatol Res 2019; 311: 731-734.

119. Wang AR, Qureshi AA, Drucker AM. Insight into the patient experience of eczema through a crowdsourcing approach. J Allergy Clin Immunol Pract 2017; 5: 861-863.

120. Nikfarjam A, Ransohoff JD, Callahan A, et al. Early Detection of Adverse Drug Reactions in Social Health Networks: A Natural Language Processing Pipeline for Signal Detection. JMIR Public Health Surveill 2019; 5: e11264. Published 2019 Jun 3.

121. Muralidhara S, Paul MJ. #Healthy Selfies: Exploration of Health Topics on Instagram. JMIR Public Health Surveill 2018; 4: e10150.

122. St Claire KM, Rietcheck HR, Patel RR, et al. An assessment of social media usage by dermatology residency programs. Dermatol Online 2019; 25: 13030/qt5v62b42z. Published 2019 Jan 15.

123. Tapking C, Popp D, Hundeshagen G, et al. Evaluation of the Online-Presence of ABA-Verified Burn Centers. J Burn Care Res 2020; 41: 1063-1068.

124. Hu S, Laughter MR, Dellavalle RP. Reliability of self-reported data on social media versus National Residency Match Program charting outcomes for dermatology applicants. J Am Acad Dermatol 2020; 83: 1842-1844.

125. Shmuylovich L, Grada A, Daneshjou R. Social Media: A New Tool for Scientific Engagement. J Invest Dermatol 2020; 140: 1884-1885.

126. Ko LN, Rana J, Burgin S. Incorporating social media into dermatologic education. Dermatol Online J 2017; 23: 13030/qt89c6h0j0. Published 2017 Oct 15.

127. Martin A, Lang E, Ramsauer B, et al. Continuing medical and student education in dermatology during the coronavirus pandemic - a major challenge. J Dtsch Dermatol Ges 2020; 18: 835-840.

128. Guckian J, Utukuri M, Asif A, et al. Social media in undergraduate medical education: A systematic review. Med Educ 2021; 55: 1227-1241.

129. Kunzler E, Graham J, Mostow E. Motivating medical students by utilizing dermatology-oriented online quizzes. Dermatol Online J 2016; 22: 13030/qt0p31j0z8.

130. Alhalabi N, Salloum R, Aless A, et al. Messaging apps use in undergraduate medical education: The case of National Medical Unified Examination. Ann Med Surg (Lond). 2021; 66: 102465. Published 2021 Jun 5.

131. Rinner C, Kittler H, Rosendahl C, et al. Analysis of Collective Human Intelligence for Diagnosis of Pigmented Skin Lesions Harnessed by Gamification Via a Web-Based Training Platform: Simulation Reader Study. J Med Internet Res 2020; 22: e15597. Published 2020 Jan 24.

132. Madke B, Gardner JM. Enhanced Worldwide Dermatology-Pathology Interaction via Facebook, Twitter, and Other Social Media Platforms. Am J Dermatopathol 2018; 40: 168-172

133. Cheng W, Wang C, Tang W, et al. Promoting routine syphilis screening among men who have sex with men in China: study protocol for a randomised controlled trial of syphilis self-testing and lottery incentive. BMC Infect Dis 2020; 20: 455. Published 2020 Jun 29.

134. Golbari NM, Porter ML, Kimball AB. Online communications among hidradenitis suppurativa patients reflect community needs. J Am Acad Dermatol 2019; 80: 1760-1762.

135. Jia JL, Nguyen B, Mills DE, et al. Comparing online engagement and academic impact of dermatology research: An Altmetric Attention Score and PlumX Metrics analysis. J Am Acad Dermatol 2020; 83: 648-650.

136. Wei C, Allais B, Tornberg HN, et al. The utilization of the Altmetric and PlumX scores in evaluating the top 100 trending melanoma articles in social media. J Am Acad Dermatol 2021; 85: 1653-1655.

137. Molina-Ruiz AM, García-Gavín P, García-Gavín J, et al. Actas 2.0: Actas Dermosifiliográficas joins the world of social networking. Actas Dermosifiliogr 2013; 104: 735-737.

138. Altman E, Dellavalle R, Grant-Kels J, et al. New ways to learn: Enhanced social media and JAAD virtual journal club 1 year later. J Am Acad Dermatol 2020; 82: 31.

139. Barber K. YouTubing to Success / Maîtrisez la chirurgie de la peau grâce à YouTube. J Cutan Med Surg 2016; 20: 373-374.

140. Uppal SK, Kearns DG, Chat VS, et al. Dermatologists as social media contributors during the COVID-19 pandemic. Cutis 2020; 106: 245-246.

141. Mazer BL, Fuller MY, Lepe M, et al. Social Media in Pathology: Continuing a Tradition of Dialogue and Education. Arch Pathol Lab Med 2018; 142: 889-890.

142. Orenstein LA, Benabio J, Stoff BK. E-professionalism at the dermatology office: new challenges to confidentiality in the era of social networking. J Am Acad Dermatol 2013; 68: 1030-1033.

143. Tamminga MA, Lipoff JB. Understanding sunscreen and photoprotection misinformation on parenting blogs: A mixed-method study. Pediatr Dermatol 2021; 38: 88-91.

144. Carrington AE, Kitts S, Kleinwaks E, et al. Vitiligo on YouTube: A cross-sectional analysis. J Am Acad Dermatol 2022; 86: 199-201.

145. Menzies S, Daly S, McKenna DB. Social media and psoriasis treatment: what are people saying on Twitter? Br J Dermatol 2019; 180: 1527-1528.

146. Hossler EW, Conroy MP. YouTube as a source of information on tanning bed use. Arch Dermatol 2008;144: 1395-1396.

147. Yan AC. Current Trends in Social Media-Associated Skin Harm Among Children and Adolescents. Dermatol Clin 2019; 37: 169-174.

148. Kanellis VG. Sharing recipes and creating potentially dangerous homemade sunscreens. Australas J Dermatol 2020; 61: 161.

149. Urso B, Updyke KM, Domozych R, et al. Acne treatment: analysis of acne-related social media posts and the impact on patient care. Cutis 2018; 102: 41-43.

150. Maymone MBC, Laughter M, Dover J, et al. The malleability of beauty: perceptual adaptation. Clin Dermatol 2019; 37: 592-596.

151. Olayinka JT, Gohara MA, Ruffin QK. #BlackGirlMagic: Impact of the social media movement on Black women's self esteem. Int J Womens Dermatol 2021; 7: 171-173. Published 2021 Jan 9.

152. Alhayaza G, Chisti M, Binamer Y. The impact of social media on dermatologists and in captivating their patients: a cross-sectional study. J Dermatol Treat 2021 [published online ahead of print, 2021 Jun 21]. https://doi.org/10.1080/09546634.2021.1940809.

153. Wang JV, Rieder EA, Schoenberg E, et al. Patient perception of beauty on social media: Professional and bioethical obligations in esthetics. J Cosmet Dermatol 2020; 19: 1129-1130.

154. Wang JV, Schoenberg E, Rohrer T, et al. Stem cells in aesthetic dermatology: bioethical and professional obligations. Arch Dermatol Res 2019; 311: 833-835.

155. Muzumdar S, Grant-Kels JM, Farshchian M. Ethics of social media marketing by dermatologists. J Am Acad Dermatol 2021; 85: 277-278.

156. Dawson AL, Hamstra AA, Huff LS, et al. Online videos to promote sun safety: results of a contest. Dermatol Reports 2011; 3: e9. Published 2011 Jun 23.

157. Szeto MD, Presley CL, Pulsipher KJ, et al. Dermatologist influencers on social media: Instagram Reels and TikTok interactive short videos. J Am Acad Dermatol 2021; 85: e185-e188.

158. Schneiderbanger CK, Schuler G, Heinzerling L, et al. Characterization of tanning behavior assessed via online survey: Attitudes, habits, and preventive measures with focus on sunscreen use. Photodermatol Photoimmunol Photomed 2019; 35: 268-274.

159. Reynolds KA, Pithadia DJ, Lee EB, et al. A cross-sectional study of YouTube videos about psoriasis biologics. Int J Dermatol 2019; 58: e61-e62.

160. Eid ES, Khoury DM, Vashi NA, et al. The communicative paradigm shift of the digital age: The skinny on social media [published online ahead of print, 2021 May 22]. J Cosmet Dermatol 2021; https://doi.org/10.1111/jocd.14242.

161. Torres A, Konda S, Nino T, et al. Medicolegal issues. Clin Dermatol 2016; 34: 106-110.

162. Jhawar N, Lipoff JB. Variable potential for social media platforms in raising skin cancer awareness. Dermatol Online J 2019; 25: 13030/qt2t78m4x1. Published 2019 Jun 15.

163. Güder S, Güder H. "Mole removal" on Instagram hashtags: a cross-sectional analysis: nevus treatment methods on ınstagram. *Dermatol Pract Concept.* 2022;12(1):e2022066. doi:10.5826/dpc.1201a66

164. Lau KHV, Farooque P, Leydon G, *et al*. Using learning analytics to evaluate a video-based lecture series. *Med Teach* 2018; **40(1)**:91–8. doi:10.1080/0142159X.2017.1395001

165. Zaila KE, Osadchiy V, Anderson AS, *et al*. Popularity and worldwide reach of targeted, evidence-based internet streaming video interventions focused on men's health topics. *Transl Androl Urol* 2020; **9(3)**:1374–81. doi:10.21037/tau-20-580