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Using telemedicine in the management of asthma patients: Perceptions of practioners in the Marrakech region.

THESIS

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BY

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Born on January 26 th, 1998 in Marrakech

TO OBTAIN THE DEGREE OF DOCTOR OF MEDECINE

KEY WORDS

Telemedicine – Asthma Management – Partitioners' Perceptions and Opinions

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قَالُوا۟ سُبْحَٰنَكَ لَا عِلْمَ لَنَآ إِلَّا مَا عَلَّمْتَنَآ ۖ إِنَّكَ أَنتَ ٱلْعَلِيمُ ٱلْحَكِيمُ ﴿٣٢﴾

صَدَقَ ٱللَّهُ ٱلْعَظِيمُ

Hippocratic Oath

At this time of being admitted as a member of the medical profession,

I solemnly pledge myself to consecrate my life to the service of humanity;

I will give to my teachers the respect and gratitude which is their due;

I will practice my profession with conscience and dignity;

The health of my patients will be my first consideration;

I will respect the secrets which are confined in me;

I will maintain by all means in my power, the honor and noble traditions of the medical profession;

My colleagues will be my brothers and sisters;

I will not permit consideration of religion, nationality, race, gender, politics, socioeconomic standing or sexual orientation intervene between my duty and my patient;

I will maintain the utmost respect for human life;

Even under threat, I will not use my medical knowledge contrary to laws of humanity;

I make these promises solemnly, freely and upon my honor.

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312	AMOCH Abdelaziz	Pr Ass	Urologie
313	ZAHLAN Safaa	Pr Ass	Neurologie
314	EL MAHFOUDI Aziz	Pr Ass	Gynécologie-obstétrique
315	CHEHBOUNI Mohamed	Pr Ass	Oto-rhino-laryngologie
316	LAIRANI Fatima ezzahra	Pr Ass	Gastro-entérologie
317	SAADI Khadija	Pr Ass	Pédiatrie
318	DAFIR Kenza	Pr Ass	Génétique
319	CHERKAOUI RHAZOUANI Oussama	Pr Ass	Neurologie
320	ABAINOU Lahoussaine	Pr Ass	Endocrinologie et maladies métaboliques
321	BENCHANNA Rachid	Pr Ass	Pneumo-phtisiologie
322	TITOU Hicham	Pr Ass	Dermatologie
323	EL GHOUL Naoufal	Pr Ass	Traumato-orthopédie
324	BAHI Mohammed	Pr Ass	Anesthésie-réanimation
325	RAITEB Mohammed	Pr Ass	Maladies infectieuses
326	DREF Maria	Pr Ass	Anatomie pathologique
327	ENNACIRI Zainab	Pr Ass	Psychiatrie
328	BOUSSAIDANE Mohammed	Pr Ass	Traumato-orthopédie
329	JENDOUZI Omar	Pr Ass	Urologie
330	MANSOURI Maria	Pr Ass	Génétique

331	ERRIFAIY Hayate	Pr Ass	Anesthésie-réanimation
332	BOUKOUB Naila	Pr Ass	Anesthésie-réanimation
333	OUACHAOU Jamal	Pr Ass	Anesthésie-réanimation
334	EL FARGANI Rania	Pr Ass	Maladies infectieuses
335	IJIM Mohamed	Pr Ass	Pneumo-phtisiologie
336	AKANOUR Adil	Pr Ass	Psychiatrie
337	ELHANAFI Fatima Ezzohra	Pr Ass	Pédiatrie
338	MERBOUH Manal	Pr Ass	Anesthésie-réanimation
339	BOUROUMANE Mohamed Rida	Pr Ass	Anatomie
340	IJDDA Sara	Pr Ass	Endocrinologie et maladies métaboliques
341	GHARBI Khalid	Pr Ass	Gastro-entérologie
342	ATBIB Yassine	Pr Ass	Pharmacie clinique
343	EL GUAZZAR Ahmed (Militaire)	Pr Ass	Chirurgie générale
344	MOURAFIQ Omar	Pr Ass	Traumato-orthopédie
345	HENDY Iliass	Pr Ass	Cardiologie
346	HATTAB Mohamed Salah Koussay	Pr Ass	Stomatologie et chirurgie maxillo faciale

LISTE ARRETEE LE 04/10/2024

DEDICATIONS

Tout d'abord à ALLAH

Le tout puissant et miséricordieux, qui m'a donné la force et la patience d'accomplir ce modeste travail.

Qui m'a inspirée et guidée dans le bon chemin, Je lui dois ce que je suis devenue.

Louanges et remerciements pour sa clémence et sa miséricorde.

الْحَمْدُ لِلَّهِ الَّذِي بِنِعْمَتِهِ تَتِمُّ الصَّالِحَاتُ

À mes chers parents,

Merci de m'avoir donné la vie et de m'avoir offert une enfance épanouie, pleine d'amour, de soin et de tendresse. Merci d'avoir toujours été présents à mes côtés, avec un soutien indéfectible. Merci de m'avoir aimé sans condition. Je vous dois tout, et aucune action de ma part ne saurait rendre hommage à l'immensité de vos sacrifices et efforts pour moi. Votre amour est un cadeau inestimable que je porterai en moi à jamais.

À mon aimable père, mon modèle, Abousaad Mohamed,

À toi, mon père, je dédie cette thèse aujourd'hui, il me semble que, par cet accomplissement, j'ai réalisé l'un de tes rêves les plus chers. Je sais que tu es fier de moi, et cela me touche profondément. Tu es un homme d'une grande sensibilité, d'une gentillesse infinie, et tous ceux qui ont croisé ton chemin le savent. Toujours prêt à aider, tu nous as offert bien plus que de simples ressources matérielles. Tu nous as donné ton amour inconditionnel, une éducation précieuse, et des valeurs profondes qui me guident chaque jour : la responsabilité, la bienveillance et une serviabilité sans mesure envers les autres. Tu as su incarner ce que signifie être vraiment généreux, non seulement par tes actions, mais aussi par ton cœur, toujours tourné vers le bien-être des autres.

Bien que je te taquine parfois sur la longueur de tes récits détaillés, rien ne me réjouit davantage que nos conversations et nos rires partagés. Nous avons une complicité unique, un lien fort que rien ne pourra jamais altérer. Aujourd'hui, je veux te dire que je serai toujours là pour toi, à chaque instant, et surtout dans les moments difficiles. Je serai ton soutien, comme tu as toujours été le mien. Je prie pour que ta santé s'améliore, inchallah. Je t'aime, papa, plus que tu ne peux l'imaginer, et je te serai éternellement reconnaissante pour tout ce que tu as fait et continues à faire pour nous.

À mon idole, ma merveilleuse mère, Rais Samira,

Tu es l'incarnation de la confiance et de la force, une femme au caractère exceptionnel. Tu es ma source d'inspiration par ton ambition, ton travail acharné et ta volonté constante de t'améliorer. Tu es le pilier de cette famille, et j'admire la manière dont tu arrives à tout concilier avec une telle grâce. Tes sacrifices pour nous sont innombrables, et aucune parole ni aucun acte ne saurait jamais les rendre justice. Ta prière et ta bénédiction m'ont été d'une grande source de force infinie tout au long de mon parcours. Je me reconnais dans tant de tes gestes et de tes valeurs, tu es ma confidente, celle qui sait tout de moi, mon soutien indéfectible dans chaque étape de ma vie, je sais que tu me guideras toujours avec amour et sagesse.

Je t'admire profondément, J'adore te voir rire aux éclats, souvent à cause de mes blagues les plus farfelues et mes imitations, ton rire est un rayon de soleil dans notre quotidien et me réchauffe le cœur. Merci de nous avoir, inculqué la confiance en nous-mêmes et l'estime de soi. Grâce à toi, nous savons que rien n'est impossible, et que nous avons toutes les clés pour réussir. Je ne peux oublier de dire que tu es sans conteste la plus belle femme que j'aie jamais vue, mais aussi par la beauté de ton âme, qui illumine tout autour de toi. Je t'aime maman plus que tu ne peux l'imaginer, et je serai toujours reconnaissante d'être ta fille.

À mes sœurs,

À mes chéries, qui ne sont plus des petites filles, je vous aime profondément. En tant qu'aînée, je ressens une grande responsabilité envers vous et j'espère être à la hauteur de cette tâche. Vous êtes une source constante de fierté et d'inspiration pour moi, et je ferai toujours de mon mieux pour vous soutenir et vous guider. Vous grandissez si vite, mais dans mon cœur, vous resterez toujours mes petites.

À ma sœur Wissal Abousaad,

Je ne trouve pas les mots pour exprimer à quel point je suis fière de toi. Tu es une véritable battante, tu ne renonces jamais. Après chaque obstacle, tu trouves la force de te relever, de tourner la page et de revenir encore plus forte. C'est ta qualité la plus admirable parmi tant d'autres. Tu es bienveillante, drôle, indépendante, déterminée, et toujours un soutien précieux. Je t'aime profondément, même si je te taquine souvent. Prends-le comme une preuve de mon affection d'aînée. J'ai hâte de te voir évoluer en une femme forte et accomplie.

À ma sœur Nihal Abousaad,

À la benjamine de notre famille, la plus gâtée et la plus aimée,
Tu es une âme douce et généreuse, empreinte d'altruisme et de compassion. J'admire ta détermination et la force avec laquelle tu poursuis tes convictions. Je suis infiniment fière de la personne que tu deviens chaque jour.
Je sais que tu penses parfois que je suis trop intrusive ou que je m'immisce dans tes affaires, mais sache que cela vient d'un amour profond et d'un désir de te protéger et de toujours vouloir le meilleur pour toi.
Je t'aime profondément, et tu pourras toujours compter sur moi, quoi qu'il arrive.

À la mémoire de ma très chère grand-mère paternelle, Hajja Malika Rouhi,

Ton souvenir reste gravé dans mon cœur. Je garde précieusement tous ces instants de bonheur partagés avec toi, ces moments d'amour et de sagesse qui ont marqué mon enfance. Tu étais une femme incroyable, pleine de sagesse et porteuse d'une vie riche en histoires et en leçons. Je sais que tu serais fière de ce que j'ai accompli aujourd'hui. Ton amour continue de m'accompagner chaque jour.

À ma douce grand-mère maternelle, Zaher Touria,

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À mon cher grand-père extraordinaire, Rais Omar,

Tu es une force de vie à toi seul, une personnalité unique qui illumine chaque instant. Ta générosité sans limite, ton humour irrésistible et ta nature compétitive rendent chaque moment passé à tes côtés inoubliable. Tes histoires, toujours captivantes et racontées avec tant de talent, résonnent comme des épopées qui nous font rire et rêver. Merci d'être cet esprit audacieux et joyeux qui rassemble et inspire toute la famille. Tu es une véritable légende parmi nous.

À ma tante Abousaad Zineb « Amito »,

Ma chère tante, tu es bien plus qu'une simple tante pour moi, tu es ma seconde maman, mon refuge, ma confidente. Ta présence douce et apaisante a marqué chaque étape de ma vie. Ton amour inconditionnel, ta bienveillance sans limite, et ta capacité à prendre soin des autres avec tant de générosité font de toi une personne exceptionnelle. Tu occupes une place immense dans mon cœur, et je me considère chanceuse et honorée de pouvoir me dire ta fille. Merci d'être ce pilier de douceur et de réconfort qui illumine ma vie.

À ma tante Abousaad Rachida « Aan », l'enseignante aux grandes valeurs,

Tu es une femme remarquable, respectée et admirée par tous ceux qui ont la chance de te connaître, qu'ils soient amis, famille ou élèves. Ton dévouement envers les autres, ton sens des valeurs et ta générosité sans faille sont une véritable inspiration. J'adore ta passion pour les voyages, ton esprit curieux et ton envie de découvrir le monde. Chaque conversation avec toi est un enrichissement, et je suis fière de toi.

À mon oncle, Abousaad Omar,

Tu es un homme dévoué, qui a consacré sa vie à servir les autres membres de la famille avec une générosité et un dévouement exemplaire. Tu as souvent pris sur toi les tâches les plus exigeantes, toujours avec bonté et humilité. Je garde des souvenirs remplis de joie de nos moments partagés, de ton humour si particulier et de ta manière inimitable de mimer les autres pour nous faire rire. Ta gentillesse et ton esprit jovial ont marqué ma vie, et je t'en serai toujours profondément reconnaissante.

À ma tante, Rais Latifa, ma confidente et mon petit cœur,

Tu es bien plus qu'une tante pour moi : tu es une confidente précieuse, une alliée de cœur et une amie proche. Tu as un cœur immense, une écoute inégalée et une générosité sans limites. Ta beauté intérieure et extérieure, ta sagesse et ton sens aigu des conseils m'impressionnent à chaque fois. J'aime nos discussions et la sérénité que tu sais apporter dans mes moments d'hésitation. Merci pour tout ce que tu es et tout ce que tu fais. Je t'aime infiniment, et sache que tu pourras toujours compter sur moi, aujourd'hui comme pour toujours.

À ma tante, Rais Layla et son mari EL mourabit Abdellah,

Merci à vous deux pour tout le soutien que vous m'avez apporté. Vous avez toujours été là dans les moments importants, créant des souvenirs inoubliables avec vos enfants, mes chers cousins. Ma tante, ton amour immense et inébranlable pour tes enfants est véritablement admirable, et cela se ressent dans tout ce que tu fais. Tu as un esprit brillant et un savoir qui semble venir si naturellement. Quant à ton mari, son sens de l'humour unique et ses blagues spéciales ont toujours su égayer nos journées. Je suis profondément reconnaissante pour tout ce que vous avez apporté dans ma vie.

À ma tante, Rais Jamila,

Ma chère tante, Tu es une femme admirable, dont la force et la résilience ne cessent de m'impressionner. Malgré les épreuves qui t'ont parfois accompagnée, tu trouves toujours le courage de te relever et de regarder l'avenir avec espoir. Ton cœur est immense, empreint de pardon et de générosité, un véritable cœur d'or. Le moment le plus marquant de nos rassemblements d'enfance était sans aucun doute l'écoute de tes histoires effrayantes. Ta façon de narrer, si envoûtante, nous laissait toujours désirer plus. Tu es une source infinie de réconfort pour nous tous, et je suis tellement reconnaissante de t'avoir dans ma vie.

À mon oncle, Rais Kamal, et sa femme Asmae,

Cher oncle, tu es un exemple de sagesse et d'intelligence. Avec tes multiples diplômes et ton esprit analytique, tu es notre référence, celui qui nous aide à raisonner et qui donne toujours les meilleurs conseils. Ta logique et ton discernement éclairent nos discussions et inspirent chacun de nous. Ta femme, avec sa personnalité authentique et spontanée, complète parfaitement cet équilibre. Vous formez un duo remarquable, et je vous admire profondément.

À mon oncle, Rais Mounir, et son épouse Kenza,

Mon cher oncle, tu es l'exemple parfait de la générosité et de l'abnégation. Enfants, tu étais toujours prêt à partager ton temps avec nous, à écouter nos histoires farfelues et à rire de nos bêtises. Tu as minutieusement documenté chaque instant, ton ordinateur étant un véritable trésor de photos et de vidéos qui racontent l'histoire de notre famille. Merci d'avoir su immortaliser ces moments précieux et de continuer à nous rassembler à travers ces souvenirs. Ta femme, quant à elle, est une personne d'une gentillesse et d'une aide infinies, toujours prête à donner sans compte.

À mes cousins(es),

***À Titi**, l'aînée de la famille, toujours élégante et appliquée, un modèle de calme et de réussite.*
***À Imane**, ma complice, celle qui apporte de la joie partout où elle passe, une personnalité pétillante qui sait toujours me faire rire, même lorsqu'elle s'endort toujours la première.*
***À Zakaria**, le génie créatif, dont les mains talentueuses transforment chaque idée en une œuvre d'art.*
***À Ismaïl**, le doux et intelligent garçon, un être lumineux qui promet un avenir brillant.*
***À Yasmine**, au caractère fort, et protecteur, qui incarne déjà parfaitement le rôle de la grande sœur.*
***À Kawtar**, La gymnaste débordant d'énergie, toujours pleine de curiosité et d'attention envers le monde qui l'entoure.*
***À Rim**, la petite espiègle aux répliques inoubliables, une âme tendre et sincère qui nous fait tous fondre.*

To RPM,

I want to start by saying that I am deeply grateful for the group "RPM" that brought us all together a bond that has become a cornerstone of my medical journey. Together, we've shared moments of pure laughter, stressful exams, medical information exchanging, heartfelt advice, and, of course, plenty of gossip. Whether it's through our light-hearted chats or our more serious discussions, our daily messages have created something truly special. This connection we share is more than just a group; it's a family that has supported and uplifted each of us through every challenge and triumph.

To Hala,

To the fiery, tiny "chaperon rouge" with a personality as bold as her stature is petite. Hala, you are truly one of a kind. I love teasing you about being the tiniest person I know, but the truth is, your spirit is anything but small. Fierce and confident, you stand tall with a strong personality that never lets anyone take advantage of you. Yet beneath that assertive exterior lies a heart so kind and caring, always wishing the best for everyone around you. Your unique blend of strength and warmth is something I deeply admire, and I am so grateful to have shared this journey with you specially in this last year as my binome.

To Tawab,

The queen of long audios and endless drama, there's truly never a dull moment in your life! Sensitive and emotional, you wear your heart on your sleeve, yet you somehow always manage to survive life's toughest moments with incredible resilience. Honestly, you could start a podcast with the sheer number of things happening in your life; I would always tune in for the entertainment. Your anger outbursts have become part of your charm, and I wouldn't have you any other way. Through all the chaos, you've been a loyal and steadfast friend, and I'm so lucky to have had you by my side.

To Chaimaa,

Chaimaa, the secret nickname you despise is a badge of love in our group, it suits you perfectly, whether you like it or not! You are the genius among us, the one with all the knowledge about apps, websites, and the one with an uncanny knack for finding solutions to any problems. What makes you even more special is your constant willingness to help, no matter how busy you are. You're an incredibly deep and talented writer with a funky blog name, I love sharing all the exclusive social media drama with you because, let's be honest, it's so fun to obsess over the nonsense together! You are truly the glue that holds us together, and we are all better for having you in our lives.

To Chaymae,

We may share the same last name, but that's where the similarities end! Our differences somehow create the perfect balance, and I love the common ground we've found. You're the social butterfly who knows absolutely everyone yet still insists you're an introvert, it's both amusing and endearing. Your singing voice might be the absolute worst, but that doesn't stop you from making us endure it, and somehow, we love you for it. Your vibrant personality and unique charm make every moment with you unforgettable.

To Zizo,

Zizo, the most extravagant person I know, with a style so bold and unique that everything you wear feels like a statement. You make me laugh harder than anyone else in the group; your sense of humour is absolutely unmatched. Your politeness and refined ideals are just as striking as your fashion sense. Always on the go, busy with mysterious tasks only you can comprehend, and walking endlessly, it's so quintessentially you. Thank you for being the quirky, dynamic spirit that keeps us all entertained and inspired. And thank you for all the law-related advice that we never listen to, even though we know it's always spot-on!

To Khawla,

Khawla, the hyperbolic storyteller of the group. You have a way of reporting every incident with such flair that we're never quite sure what to believe! Over time, we've all grown so used to your exaggerations that they've become a delightful part of who you are. Your generosity and loving nature shine through in everything you do, and your home full of animals is a testament to your big heart, even if they mysteriously disappear from time to time. You're a treasure to this group, and your unique traits make our lives so much richer.

To Taarabt,

The one with tears always on standby for no reason, the quiet observer who sees so much more than she lets on. While you may be the least interactive in our conversations, behind your reserved demeanor lies a heart full of love and compassion. You are a true friend, always there when it matters most. And of course, your unshakable confidence in delivering the most unfunny jokes, ones only you find hilarious is unmatched. Thank you for being a steady and caring part of my life; I see you, and I cherish you.

To the "Totally Spies" group,

I am profoundly grateful for your presence in my life. The long video calls, the shared travel adventures, and the countless memories we've created together have been some of the brightest highlights of my journey.

To Souad,

From the very first day I met you, I recognized in you a rare and precious quality: an unguarded heart and a trusting spirit that chooses to see the best in people. In an age where cynicism often prevails, your innocence and goodness are truly refreshing. I am so proud of the person you've become: responsible, caring, and kind. And of course, I can't forget how we used to tease you for being slow to get references. Yet, thanks to our subtle bullying, you've transformed into one of the sharpest among us, with your quick wit and clever comebacks leaving us speechless. You are truly one of a kind, and I'm so lucky to call you, my friend.

To Nissrine,

When I first met you, the impression you left was of someone genuinely kind and selflessly helpful. As I got to know you better, that impression only solidified. You are the very definition of generosity and warmth. That said, you do talk a lot, and while I often wonder how you manage to keep going, I secretly enjoy every moment of it. Your stories and chatter are never dull, and they bring an irreplaceable energy to our conversations. I can't wait to create even more memories and embark on new travels together, sharing laughter and adventures that only we can. I wish you nothing but the very best in the exciting path that lies ahead, knowing that your brilliance and compassion will lead you to great success.

To Group 1,

The individuals with whom I've shared so many memories, unforgettable anecdotes, countless exams, and shifts that have truly defined our time together. These experiences, filled with laughter, challenges, and unwavering support, will always hold a special place in my heart. I will forever cherish these moments, and no matter where life takes us, I look forward to staying connected and continuing to create more memories together.

To me,

A special thanks to myself for believing in the process, for embracing every challenge, and for always pushing forward. This moment is for me, and I'm proud of the journey, Alhamdulillah.

To my patients,

To the patients I have had the privilege of encountering during my training,
I am deeply grateful for your patience and trust. You allowed me to ask countless questions, examine you repeatedly, and learn from each interaction. Please know that I do not take the responsibility of this profession lightly, and I sincerely hope that my presence, even in these early stages, has made a positive impact on your lives. Your generosity in supporting my growth as a medical professional will forever be remembered and cherished.

To my crazy cat "baby Darko",

In just eight months, you've completely turned my world upside down. Who would've thought that someone terrified of animals would end up falling head over heels for a cat? Yet here we are, inseparable, and you've become the ruler of my heart (and my furniture). Your mix of sweetness, sass, and constant mischiefs keeps me on my toes, and honestly, I wouldn't have it any other way. I love you, le Bébé.

To all those who hold a special place in my heart and whom I may have unintentionally failed to mention, I dedicate this work as a sincere expression of my deepest respect, love, and profound gratitude.

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I am deeply honored to have had the privilege of learning under your mentorship, and I hope to carry forward the values and expertise you have instilled in us. Thank you for inspiring excellence with such poise and dedication.

To Professor AIT BATAHAR Salma supervisor of my thesis, Professor of Pulmonary Medicine at Mohammed VI University Hospital in Marrakech.

First and foremost, I would like to extend my heartfelt gratitude to you for being my thesis supervisor. I truly cannot imagine this journey with anyone else. They say that when choosing a professor for your thesis, you should decide on someone with whom you have the greatest affinity, and this has certainly proven true for me. My admiration for you began from the very first class I attended, when you taught us Medical English. You were so gracious and amiable, and your kindness and warmth were immediately evident to all of us, leaving a memorable impact that made everyone look forward to your lessons with great anticipation.

Fast forward to the present, and the experience of collaborating with you throughout my thesis has been nothing short of fulfilling. Your guidance has been invaluable, and I am constantly inspired by your sharp intellect and the wealth of amazing ideas and suggestions you bring to every discussion. You have a remarkable ability to make every step of the process feel effortless, and I thoroughly enjoy our conversations on every subject. You have such a sweet, humane presence, and your approachability makes it so easy to speak with you.

You welcome everyone with a smile and a genuine interest in their well-being, which truly embodies your strong ethics and exceptional character. Thank you for being the person you are. I aspire to one day be as kind, generous, and insightful as you. It is clear that you are beloved by all your students, and I am deeply grateful to be among them.

To Professor BOURROUS Mounir judge of my thesis, Professor of Pediatrics and esteemed chief of the Pediatrics Emergency department in the Mohamed VI University Hospital of Marrakech.

I am truly honored by your participation in my jury. Although I have not had the privilege of a clinical rotation in the pediatric emergency department, I have had numerous occasions to witness your exceptional kindness, whether during case presentations or casual visits to the department. The grace and humility with which you engage with students, colleagues, and patients alike embody the highest ideals of our profession. You bring not only a wealth of knowledge but also an atmosphere of positivity and warmth that uplifts everyone around you. Your ability to balance professionalism with genuine kindness is both admirable and inspiring.

As I advance in my own journey as a doctor, I aspire to carry forward the humility, empathy, and good humor that you exemplify so naturally. Your example reminds me that a doctor's character is as vital as their skill, and for this, I am deeply grateful.

To Professor BENJELLOUN HARZIMI Amine judge of my thesis, Professor of Pulmonary Medicine at the Avicenne Military Hospital in Marrakech.

I would like to express my sincere gratitude to you for agreeing to be a part of my jury. My first encounter with you dates back to my first year of medical school, during my very first clinical rotation. I distinctly remember how you took the time to approach me and my friend, asking us who we were. With your words, you motivated and encouraged us on the long journey that lay ahead, expressing your hope to witness our progression toward becoming doctors. As first-year students, this uplifting interaction left an indelible impression on us. It demonstrated your thoughtful and intentional nature, as well as your sincerity and modesty.

I never missed one of your lectures, as they were consistently captivating and insightful. Your ability to inspire those around you is remarkable, and I hope to one day embody the same inherent charisma and effortless confidence that you exude.

To Professor BENNAOUI Fatiha judge of my thesis, Professor of Pediatrics-Neonatology at Mohammed VI University Hospital in Marrakech.

I wish to convey my heartfelt thanks to you for agreeing to be a part of the jury for my thesis. My time in neonatology during my fourth year was truly special, and I had the privilege of attending many consultations with you. It was evident how much you love working with babies and how deeply passionate you are about your profession. I greatly appreciated your approachability and compassion, which created an environment where one always felt at ease, despite the intense and fast-paced nature of the department. Your warmth and genuine presence left a lasting impression on me.

This passion is something I deeply admire, as I believe it is one of the most important qualities a doctor can possess. I hope that, in time, I will come to love my chosen specialty with the same enthusiasm and dedication that you exhibit every day.

ABREVIATIONS

LIST OF ABBREVIATIONS

- **ADA** : American Diabetes Association
- **ADHD** : Attention Deficit Hyperactivity Disorder
- **ACT** : Asthma Control Test
- **AIDS** : Acquired Immunodeficiency Syndrome
- **AIRMAG**: Asthma Insights and Reality in the Maghreb
- **AMO** : Assurance Maladie Obligatoire (Mandatory Health Insurance)
- **ANAP** : Agence Nationale d'Appui à la Performance des Établissements de Santé et Médico-Sociaux (French National Agency for Supporting the Performance of Health and Medico-Social Institutions)
- **ARPANET** : Advanced Research Projects Agency Network
- **ATA** : American Telemedicine Association
- **BCE** : Before Common Era
- **CBT** : Cognitive Behavioral Therapy
- **CE** : Common Era
- **CHC** : Community Healthcare Center
- **CHP** : Centre Hospitalier Provincial
- **CHU Med VI** : Centre Hospitalier Universitaire Mohamed VI
- **CGM** : Continuous Glucose Meters
- **CHC** : Community Healthcare Center
- **CIRM** : Centro Internazionale Radio Medico
- **CNMC** : Children's National Medical Center
- **COPD** : Chronic Obstructive Pulmonary Disease
- **COVID-19** : Coronavirus Disease 2019
- **CT** : Computed Tomography
- **DIS** : Digital Inhaler Systems
- **DSM-IV** : Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition

- **DSMES** : Diabetes Self-Management Education and Support
- **DSS** : Decision Support System
- **ED** : Emergency Department
- **E-consults**: Electronic Consultations
- **ECHO** : Extension for Community Healthcare Outcomes
- **EEG** : Electroencephalogram
- **HER** : Electronic Healthcare Records
- **EMG** : Electromyogram
- **EVT** : Endovascular Clot Retrieval
- **FDA** : Food and Drug Administration
- **FEV1** : Forced Expiratory Volume in 1 Second
- **FMPM** : The Faculty of Medicine and Pharmacy of Marrakech
- **FVC** : Forced Vital Capacity
- **GAN** : Global Asthma Network
- **GERD** : Gastroesophageal Reflux Disease
- **GINA** : Global Initiative for Asthma
- **GP** : General Practitioners
- **HCV** : Hepatitis C Virus
- **HIV** : Human Immunodeficiency Virus
- **ICS** : Inhaled Corticosteroids
- **ICD** : Implantable Cardioverter Defibrillators
- **ICT** : Information and Communication Technologies
- **IBS** : Irritable Bowel Syndrome
- **IBD** : Inflammatory Bowel Disease
- **IOM** : Intraoperative Monitoring
- **ISAAC** : International Study of Asthma and Allergies in Children
- **ISDN** : Integrated Services Digital Network
- **LABA** : Long-Acting Beta-Agonists
- **MedSTAR** : Medical Retrieval and Support Team for Advanced Retrieval

- **mHealth** : Mobile Health
- **NASA** : National Aeronautics and Space Administration
- **NICU** : Neonatal Intensive Care Unit
- **OCS** : Oral Corticosteroids
- **Oncorad** : Oncology and Radiology
- **OSA** : Obstructive Sleep Apnea
- **PEF** : Peak Expiratory Flow
- **PHC** : Provincial Healthcare Center
- **PRISMA** : Preferred Reporting Items for Systematic Reviews and Meta-Analyses
- **PTSD** : Post-Traumatic Stress Disorder
- **Q&A** : Questions and Answers
- **RHC** : Regional Healthcare Center
- **RHF** : Rural Healthcare Facility
- **RPM** : Remote Patient Monitoring
- **SABA** : Short-Acting Beta Agonist
- **SARS-CoV-2**: Severe Acute Respiratory Syndrome Coronavirus 2
- **SMT** : Moroccan Society of Telemedicine
- **SMS** : Short Message Service
- **STARPAHC**: Space Technology Applied to Rural Papago Advanced Health Care
- **tPA** : Tissue Plasminogen Activator
- **Tele ECG** : Tele Electrocardiogram
- **TM** : Telemedicine
- **U.S** : United States
- **UC** : Urgent Care
- **UH** : University Hospital
- **VC** : Video Consultations
- **VTC** : Video Teleconferencing
- **VUC** : Virtual Urgent Care
- **WHO** : World Health Organization

- **WHO-5** : World Health Organization Well-Being Index
- **WMA** : The World Medical Association
- ® : Registered trademark
- ™ : Trademark

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INTRODUCTION

In an era characterized by rapid technological advancements and an increasing demand for accessible healthcare, telemedicine has emerged as a transformative force within the global health landscape. Defined as the delivery of healthcare services through telecommunications technology such as video conferencing, phone calls, and secure messaging, telemedicine encompasses a broad spectrum of practices, including remote consultations, monitoring, treatment and education. which has proven to be especially vital during global challenges like the COVID-19 pandemic This innovative approach not only promotes patients' convenience and greater accessibility to care but also fosters a more efficient allocation of healthcare resources, particularly in underserved regions.

As the World Health Organization (WHO) emphasizes, telemedicine has the potential to bridge the gap between patients and healthcare providers, alleviating burdens on traditional healthcare infrastructure and thereby improving health outcomes while promoting equity in healthcare access. Interestingly, the report indicates a trend of increasing telehealth utilization as income levels rise. However, it is noteworthy that even among low-income countries, during the COVID-19 crisis, 42% of those experiencing disruptions in their usual healthcare services turned to telemedicine as an alternative.(1)

Asthma, a chronic respiratory condition that affects millions of individuals worldwide, exemplifies the pressing need for effective management strategies. This debilitating disease is characterized by chronic airway inflammation and hyperreactivity, leading to recurrent episodes of exacerbation, particularly when exposed to specific risk factors such as allergens, pollutants, respiratory infections, or physical exertion (2). The economic burden of asthma is substantial, with direct and indirect healthcare estimated to exceed $80 billion annually in the United States alone as reported by the American Lung Association.(3)

Asthma not only ranks as a leading cause of morbidity globally but also contributes significantly to economic strain through high healthcare expenses associated with hospitalizations, emergency visits, and long-term medications. In addition to its direct health impacts, asthma results in considerable productivity losses due to school and work absenteeism, further diminishing the quality of life for those affected.

Given these challenges, effective asthma management is crucial and often necessitates continuous monitoring of symptoms, medications, and environmental triggers to enable timely adjustments to treatment plans. This is where the integration of telemedicine in asthma care presents a promising solution. Telemedicine offers the ability to monitor patients remotely and promptly adjust treatment strategies, thereby helping to prevent exacerbations and complications.(4)

Objectives of the study:

Recognizing the chronic nature of asthma and its profound global implications, this study seeks to investigate the promotion of telemedicine as an effective solution for the management of asthma. Through this exploration, we aim to enrich the existing body of knowledge regarding the impact of telemedicine on asthma care and its transformative potential in enhancing healthcare delivery, particularly in underserved regions. Additionally, this research will evaluate the perceptions of healthcare practitioners regarding the role of telemedicine in asthma management, encompassing aspects from routine monitoring to urgent care, as well as their opinions on reimbursement and other relevant factors influencing its implementation. Specifically, the objectives of this research are threefold:

1. To assess the perspectives of healthcare professionals regarding the utilization of telemedicine in asthma management.
2. To draw evidence-based recommendations for the remote monitoring of asthma through telecommunications technologies.
3. To support and promote the adoption of telemedicine as a standard component of asthma care.

PARTICIPANTS AND METHOD

I. Participants:

1. Study design:

Our work is an observational descriptive cross-sectional study aimed at assessing the perceptions of general practitioners, pulmonology specialists and residents in the Marrakech region regarding the use of telemedicine in managing asthma patients.

The research was carried out in both urban and rural areas of the region, targeting healthcare professionals actively involved in patient care across both public hospitals including the Mohamed VI University Hospital, peripheral and regional hospitals, community health centers as well as private independent medical offices within the Marrakech region.

For that purpose, participants were asked to complete a self-administered survey, which was created by Google forms and distributed online. The study was conducted over a period of six months, from April 2024 to September 2024.

2. Subjects of the study:

This study utilized a voluntary sampling method, without imposing criteria for age or gender among participants. They spanned various training levels and practice settings, encompassing both the private and public domains, allowing for a broad and diverse representation of healthcare providers. This approach aimed to capture a comprehensive understanding of perceptions related to the use of telemedicine in asthma care.

A total of 250 doctors participated in our survey.

a. Inclusion criteria:

- **Pulmonology residents/interns** practicing at the Mohammed VI University Hospital in Marrakech.
- **Pulmonologists and General practitioners** practicing in the Peripheral and Regional Hospital Centers of the Marrakech region:
    - Regional Hospital of Marrakech – Ibn Zohr, Al Antaki
    - Mohammed VI Peripheral Hospital – Al Haouz Province
    - Mohammed V Peripheral Hospital – Safi Province
    - Provincial Hospital Center – Essaouira Province
    - Provincial Hospital Center – Youssoufia Province
    - Provincial Hospital Center – Rehamna Province
    - Provincial Hospital Center – Kelaa des Sraghna Province
    - Provincial Hospital Center – Chichaoua Province
- **General practitioners** in community health centers in the region of Marrakech
- **Pulmonologists and General practitioners** working in the private sector in the Marrakech region.

b. Exclusion criteria:

Doctors who did not volunteer to participate in answering the questionnaire.

II. Method:

1. Survey:

The survey was designed using an anonymous questionnaire developed on Google Forms, intended to be completed in roughly 5 minutes. Written in French employing straightforward and easily understandable vocabulary. The questionnaire is organized into six sections and consists of 23 questions: 6 multiple-choice, 15 single-choice, and 2 open-ended.

Section one: **"General Information"**, outlines the doctors' status, sector, and workplace. It reports whether they receive asthma patients during routine consultations and emergencies and if they have previously utilized telemedicine in their practice.

Section two: **"Management of Asthma Attacks"**, gathers doctors' insights on managing asthma crises via telemedicine and explores its potential role in these situations.

Section three: "**Telemonitoring of Asthma patients**," explores doctors views on using telemedicine for asthma follow-up, examining the recommended frequency of telemonitoring suitable for different types of asthma, and assessing its practicality and effectiveness in long-term asthma management and potential to enhance patient monitoring and outcomes.

Section four: **"Training and Preparation**", seeks doctors' opinions on the need for specialized training for healthcare professionals involved in asthma management and asks which types of trainings would be most beneficial for effectively implementing telemedicine in their practice.

Section five: **"Tools and Technologies"**, inquires of doctors about preferred communication methods or tools for teleconsultations and their views on the ideal duration for an effective remote consultation.

Section six: **"Remuneration",** solicits doctors' opinions on whether they should be compensated for providing telemedicine services and whether health insurance providers should include teleconsultations in their coverage plans.

The final question of the survey is an open-ended one, inviting suggestions or additional comments on optimizing asthma management through telemedicine.

2. Pilot testing:

A pilot study was undertaken by administering the survey to a group of 5 doctors. This preliminary phase aimed to identify any potential issues with wording, structure, or the overall clarity and understanding of the questions. Feedback from these participants allowed for adjustments to ensure that the questionnaire would accurately capture the intended information when administered on a larger scale. The pilot study was crucial in refining the final version of the survey before its official distribution.

3. Data collection:

The questionnaire was distributed online via email, WhatsApp and Facebook to ensure ease of access and maximize participation. Email provided a formal, reliable option, while social networks such as WhatsApp and Facebook offered a quicker, more direct method, leveraging their popularity among healthcare professionals. This strategy aimed to increase response rates by accommodating to varied communication preferences.

Accompanying the questionnaire was a brief message outlining the objectives of the survey and emphasizing the significance of their participation and confidentiality of their answers.

4. Statistical analysis:

Data storage for the study was conducted automatically in real time using Google Forms. Once this phase was completed, responses were exported into Microsoft Office Excel 2019 for further processing and analysis where quantitative variables were expressed as frequencies and percentages. The findings were subsequently visualized through diagrams and charts created in Excel.

5. Ethical consideration:

- The responses are exploited solely and exclusively for scientific and academic purposes.
- Answering the questionnaire was completely voluntary.
- The anonymity of the participants was ensured during the collection of data.

RESULTS

I. General Information:

1. Respondents' Profile:

- A total of 250 participants took part in our study (N=250).
- Among them were 205 (82%) General practitioners (including interns).
- And 45 (18%) Pulmonologists (including residents).

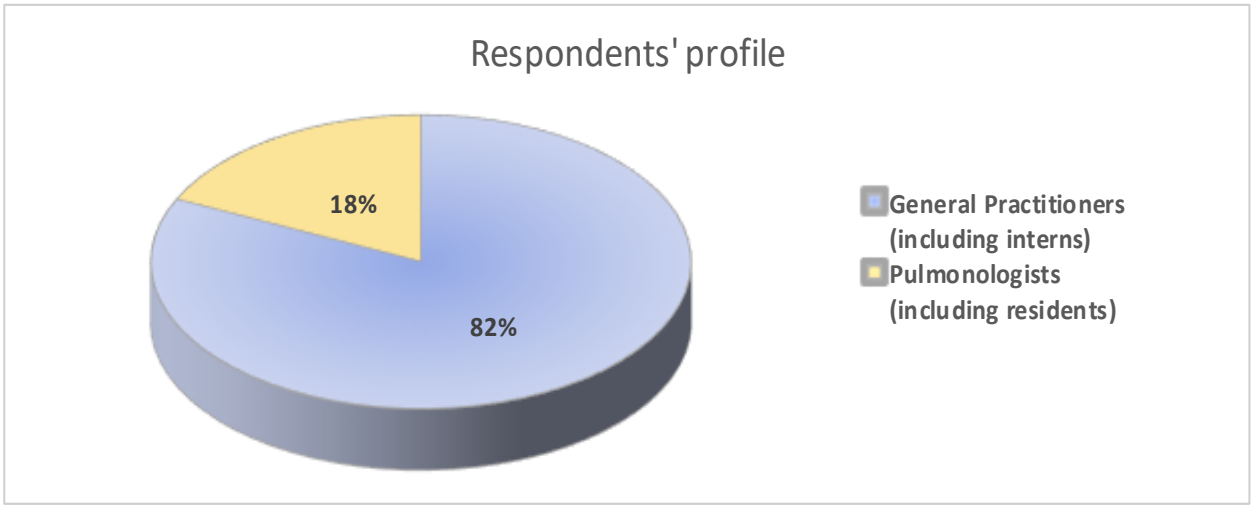

Figure 1: Participants' status.

2. Location of Practice:

In our survey, the distribution of participants was as follows:

- 158 (63.2%) participants worked in the public sector.
- 63 (25.2%) participants were affiliated with the University Hospital (UH).
- And 29 (11.6%) participants practiced in the private sector.

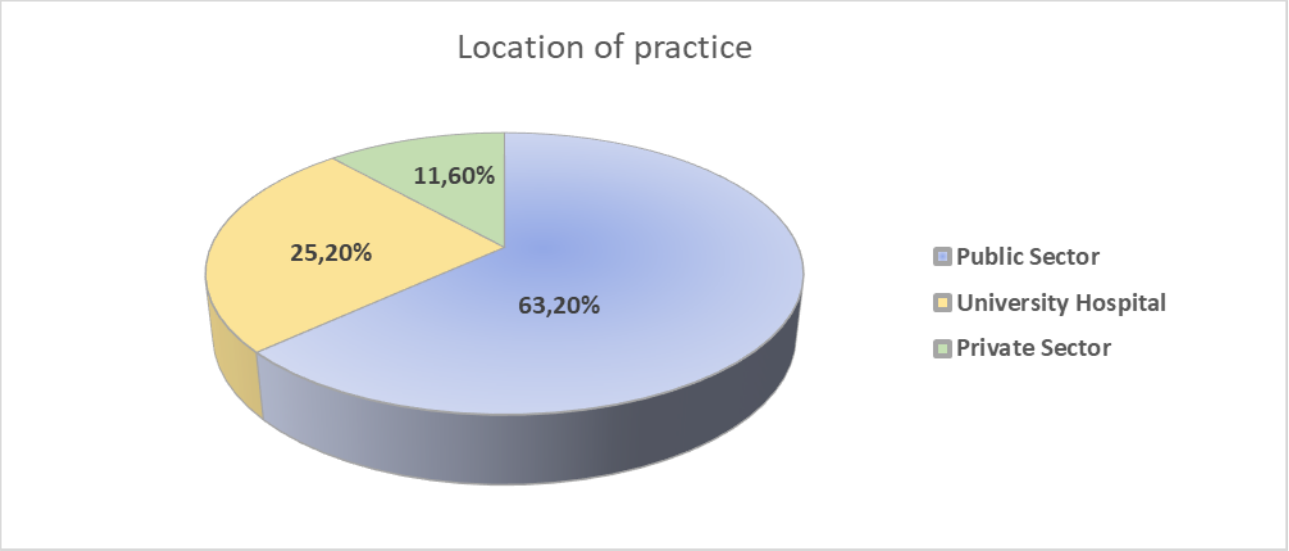

Figure 2: Distribution of practioners based on practice sector.

For the 158 (63.2%) practitioners working in the public sector, an open-ended question was included to specify their exact place of practice. The responses varied with the majority indicating they worked in peripheral hospitals in the Marrakech region.

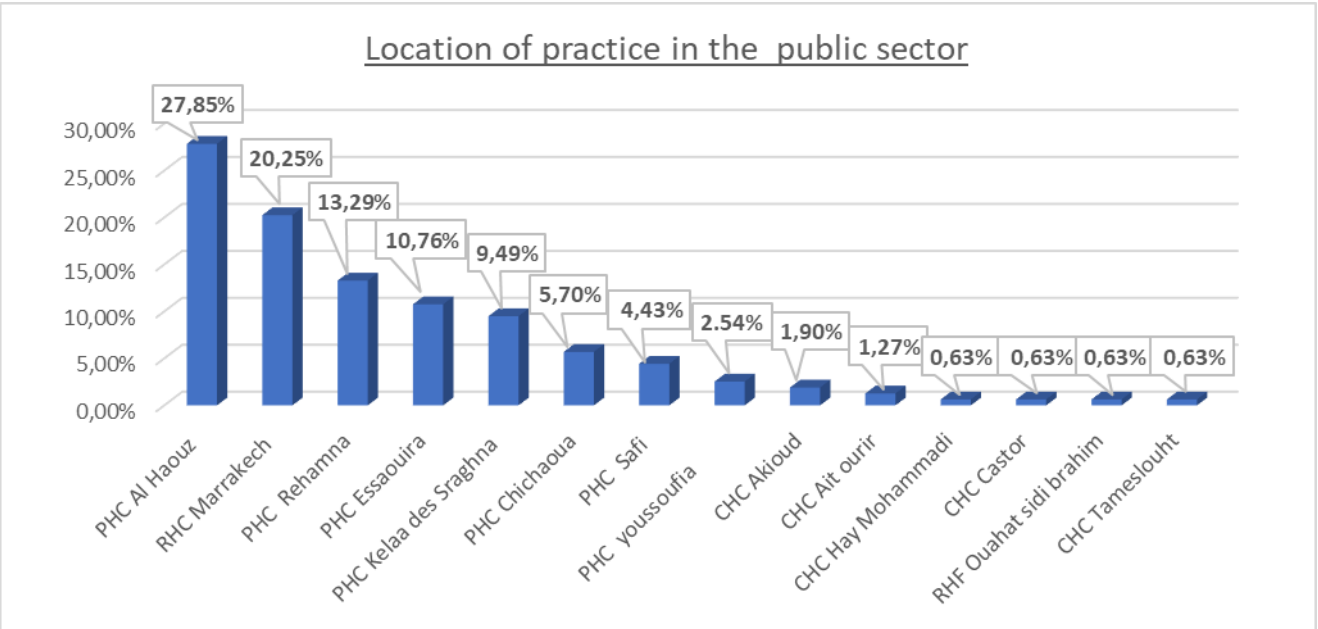

Figure 3: Specific location of practice for public sector practitioners.

Following an in-depth analysis of the individual responses, a detailed breakdown was conducted, delineating both the professional status and sector of practice of the physicians who took part in the survey. The findings reveal that a significant proportion of respondents 140 (56%) were interns practicing in the public sector precisely in peripheral hospitals.

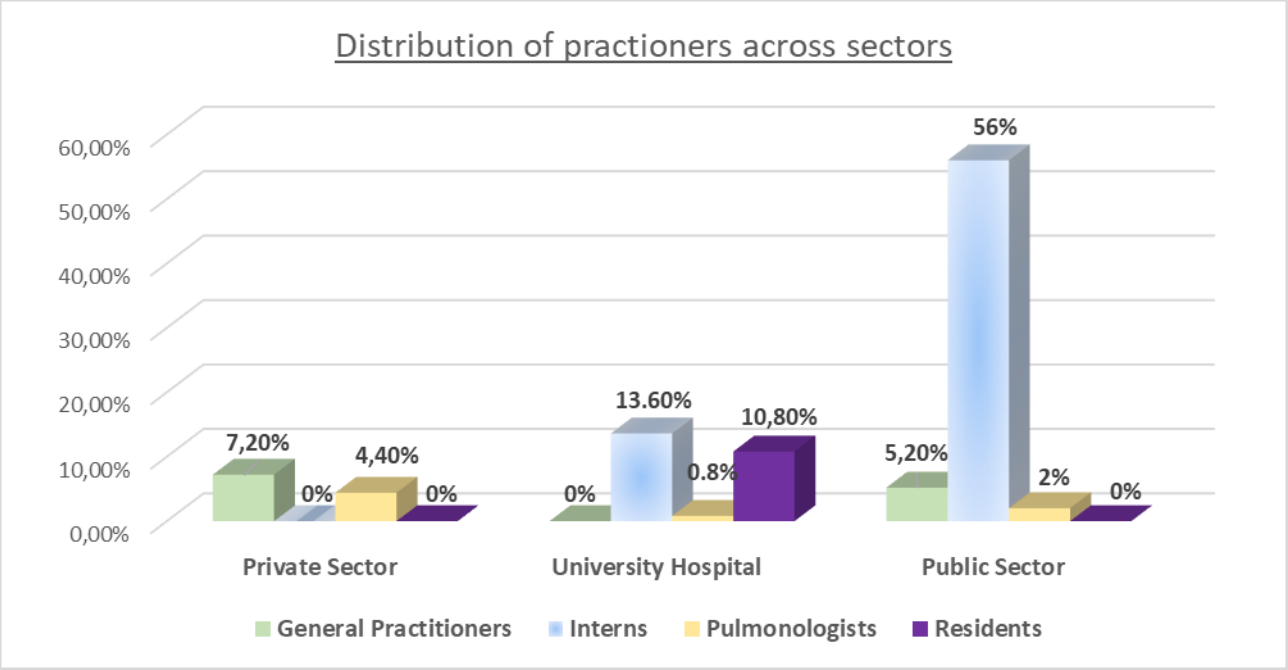

Figure 4: Healthcare Practitioner Distribution in Various Settings.

Table I, II: Respondents' profile overview:

Status / Sector	Private sector		University Hospital		Public sector		Total	
	N	%	N	%	N	%	N	%
General practitioners	18	7.20%	none	0%	13	5.20%	31	12.40%
Interns	none	0%	34	13.60%	140	56%	174	69.60%
Total GPs + interns							**205**	**82%**
Pulmonologists	11	4.40%	2	0.80%	5	2%	18	7.20%
Residents	none	0%	27	10.80%	none	0%	27	10.80%
Total pulmonologists + residents							**45**	**18%**
Overall Total	29	**11.6%**	63	**25.2%**	158	**63.2%**	250	100%

Location	Number of Practioners in the public Sector	%
Mohammed VI Peripheral Hospital – Al Haouz Province	44	27.85%
Regional Hospital of Marrakech – Ibn Zohr, El Antaki	32	20.25%
Provincial Hospital Center – Rehamna Province	21	13.29%
Provincial Hospital Center – Essaouira Province	17	10.76%
Provincial Hospital Center – Kelaa des Sraghna Province	15	9.49%
Provincial Hospital Center – Chichaoua	9	5.70%
Mohammed V Peripheral Hospital – Safi Province	7	4.43%
Provincial Hospital Center – Youssoufia Province	4	2.54%
Community healthcare Center Akioud	3	1.90%
Community Healthcare Center Ait ourir	2	1.27%
Community healthcare Center Hay Mohammadi	1	0.63%
Community Healthcare Center Castor	1	0.63%
Rural Healthcare Facility Ouahat sidi brahim	1	0.63%
Community Healthcare Center Tameslouht	1	0.63%
Total	158	100%

3. Asthma Patient caseloads:

The survey results revealed that a considerable number of 248 (99.2%) practitioners see asthma patients regularly in both routine consultations and emergency situations.

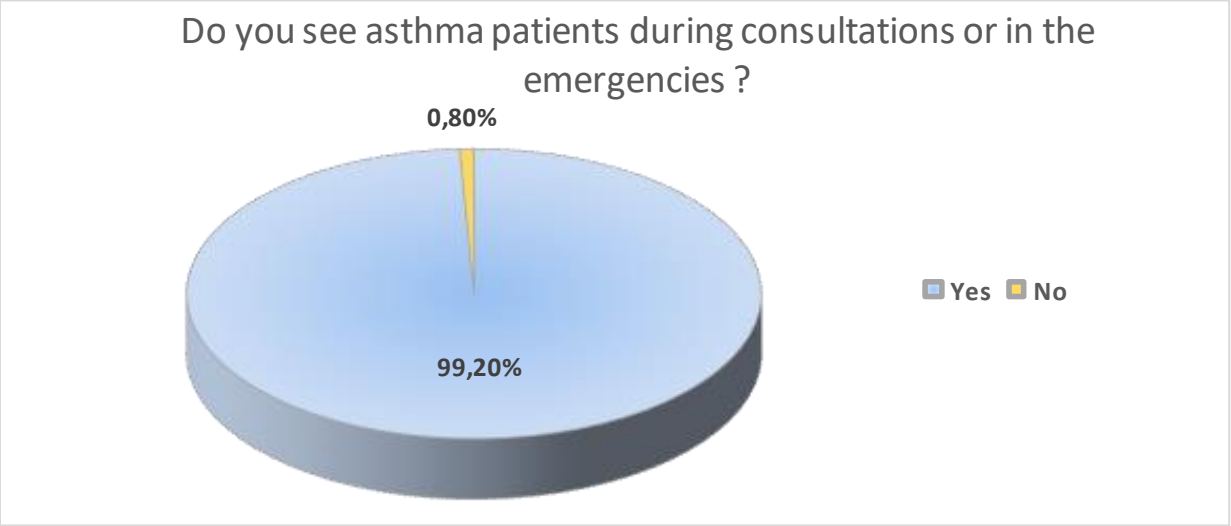

Figure 5: Proportion of Healthcare Providers Treating Asthma Patients.

When asked about their weekly caseloads, 66 (26.61%) of practitioners see fewer than 5 asthma patients per week, 99 (39.92%) see between 5 and 10, and 83 (33.47%) manage more than 10 patients weekly.

The two participants who responded "no" to the preceding question did not provide a response to this one.

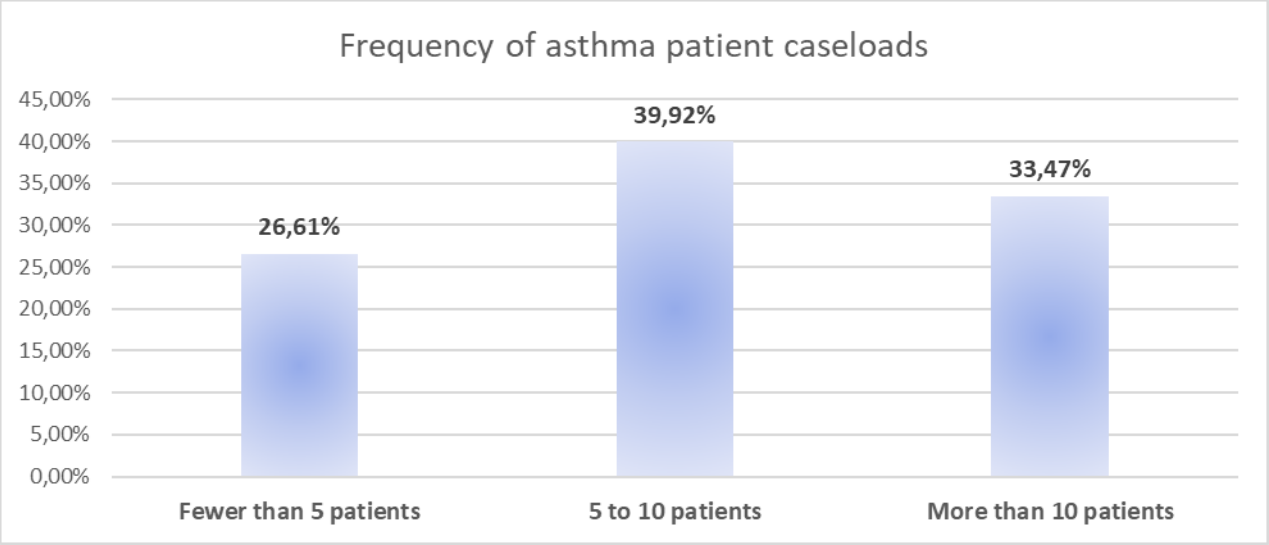

Figure 6: Weekly Asthma Patient Caseloads Among Practitioners.

4. Use of Telemedicine in Current Medical Practice:

Our survey indicated that 154 practitioners (61.6%) have prior experience with telemedicine, reflecting a growing acceptance of technology in healthcare. In contrast, 96 practitioners (38.4%) reported that they have never engaged with telemedicine services.

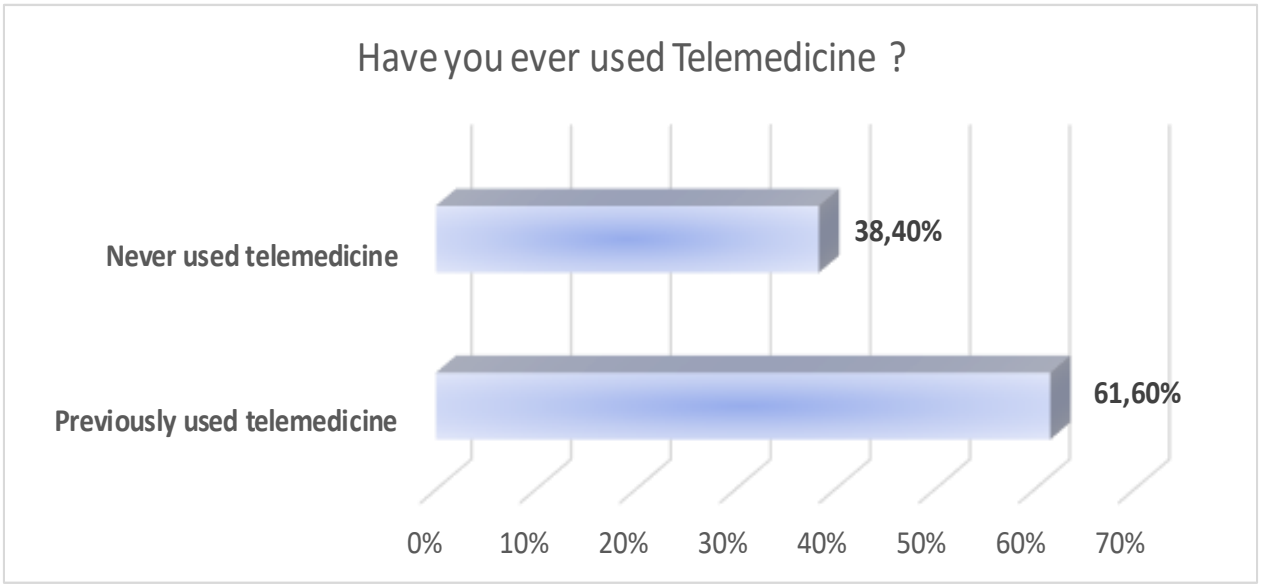

Figure 7: Telemedicine Adoption Rates Among Practitioners.

5. Perception of Liability:

The survey results revealed that a significant majority of physicians 231 (92.4%) believe that telemedicine engages their civil and professional liability, meaning they consider themselves legally accountable for the medical advice and treatment provided through remote consultations. Conversely, a smaller portion, 19 (7.6%) hold the opposite opinion.

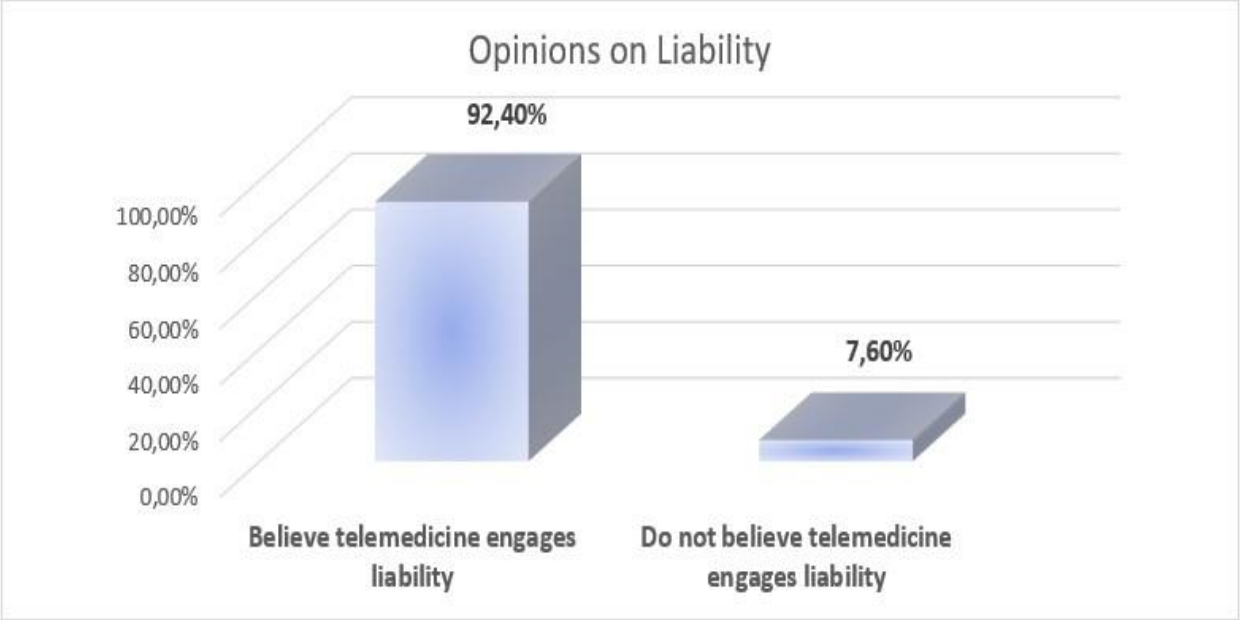

Figure 8: Physicians' Views on Telemedicine and Liability.

II. Management of Asthma Attacks:

1. Support for Telemedicine in Managing Asthma Attacks:

In response to inquiries regarding the acceptance of telemedicine for the management of asthma attacks, 116 practitioners (46.4%) indicated a tentative stance, responding with "maybe". Additionally, 103 practitioners (41.2%) expressed agreement with the approach, while 31 practitioners (12.4%) opposed it.

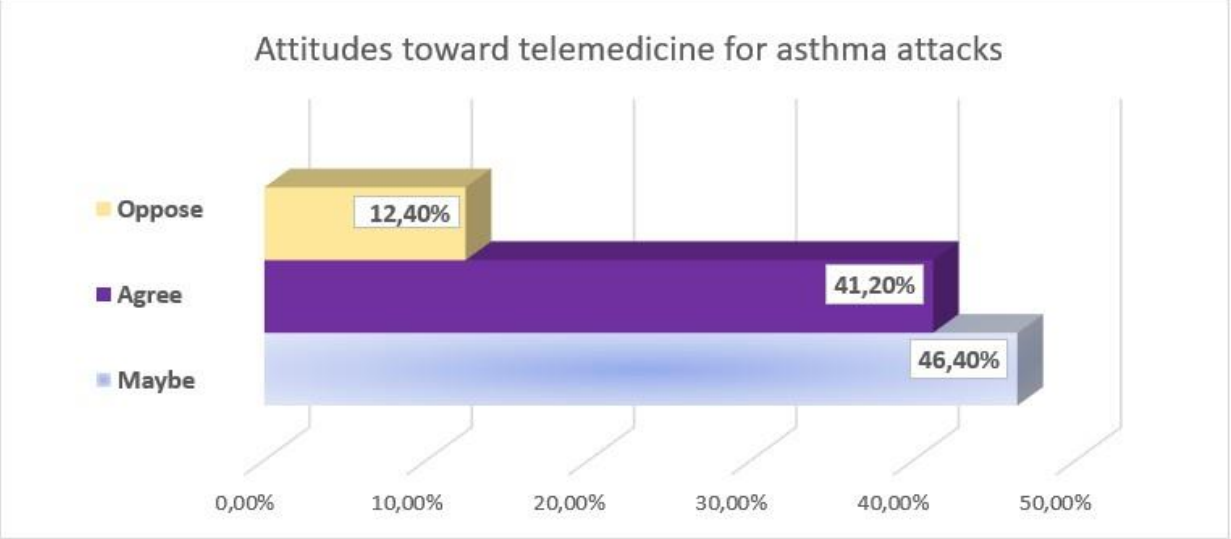

Figure 9: Practitioners' Acceptance of Telemedicine for Asthma Management.

2. Types of Asthma Attacks Perceived as Manageable via Telemedicine:

If practitioners responded affirmatively to the previous question, they were prompted to specify the types of asthma attacks they would be willing to manage via telemedicine.

The results indicated that a significant majority, 205 (93.2%) selected "Mild attack", followed by 125 (56.8%) opting for "Moderate attack". Only 21(9.5%) indicated a willingness to manage "Severe attack".

Notably, this was a multiple-choice question, with a total of 219 practitioners providing responses.

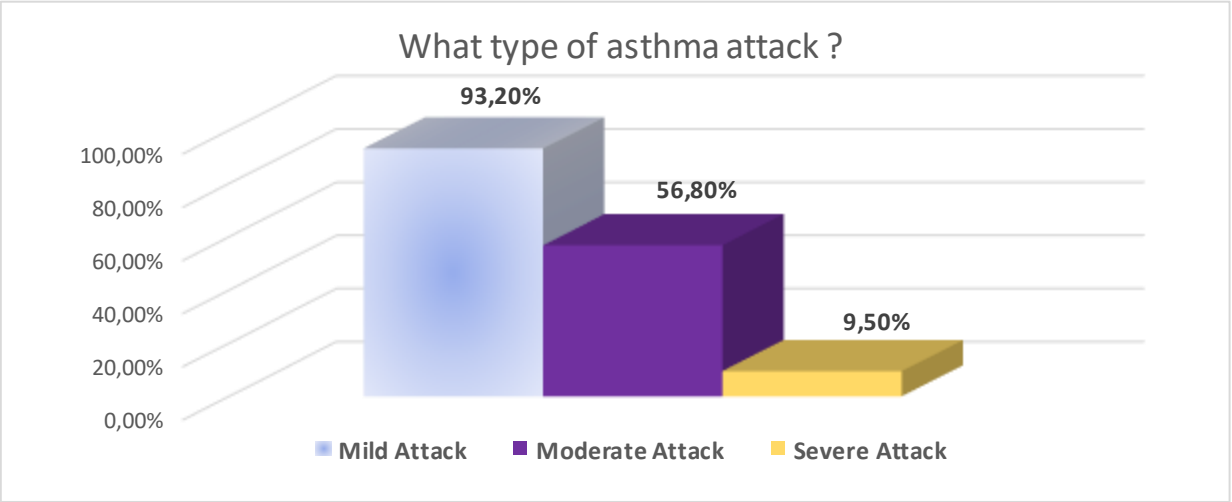

Figure 10: Management Preferences by Severity of Asthma Attacks.

3. Role of Telemedicine in Managing Asthma Attacks:

In response to a multiple-choice question regarding the perceived role of telemedicine in managing asthma attacks, the results revealed that a significant majority of practitioners 217 (86.6%), selected "Providing advice to prevent future attacks". This was followed closely by two other options: 177 (70.8%) chose "Immediate treatment at the site of the attack prior to emergency care", while 168 (67.2%) selected "Assessing the severity of the attack". However, the least selected option was " Deciding on further treatment in a medical facility, if necessary", with only 70 practitioners (28%) indicating this proposition. Suggesting that there may be a hesitance to rely on telemedicine for critical decision-making, especially in urgent situation.

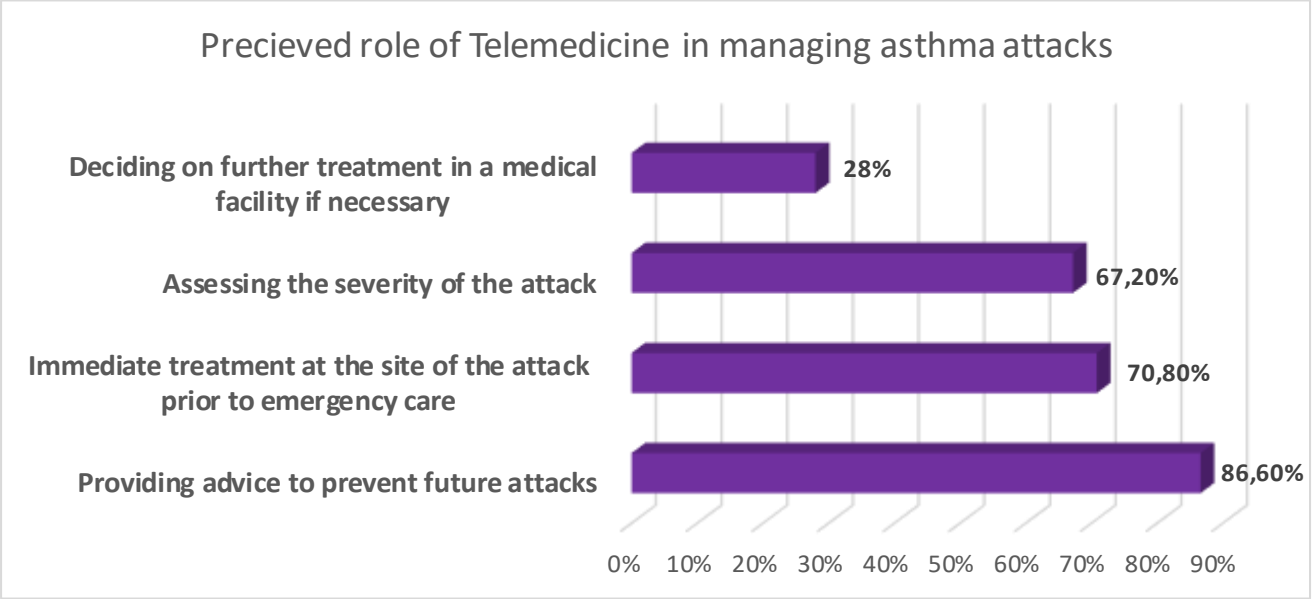

Figure 11: Telemedicine's Role in Managing Asthma Attacks.

III. Telemonitoring of Asthma Patients:

1. Positions on Telemedicine in Asthma Patient Monitoring:

To assess practitioners' perspectives on telemonitoring, the question: "Are you in favor of using telemedicine for asthma patients' follow-ups?" was posed. The results revealed a substantial level of support, with 175 practitioners (70%) expressing affirmative responses.

A notable proportion, 66 practitioners (26.4%), remained uncertain, indicating a willingness to consider the option but not fully committing. And only 9 practitioners (3.6%) opposed the use of telemedicine for this purpose.

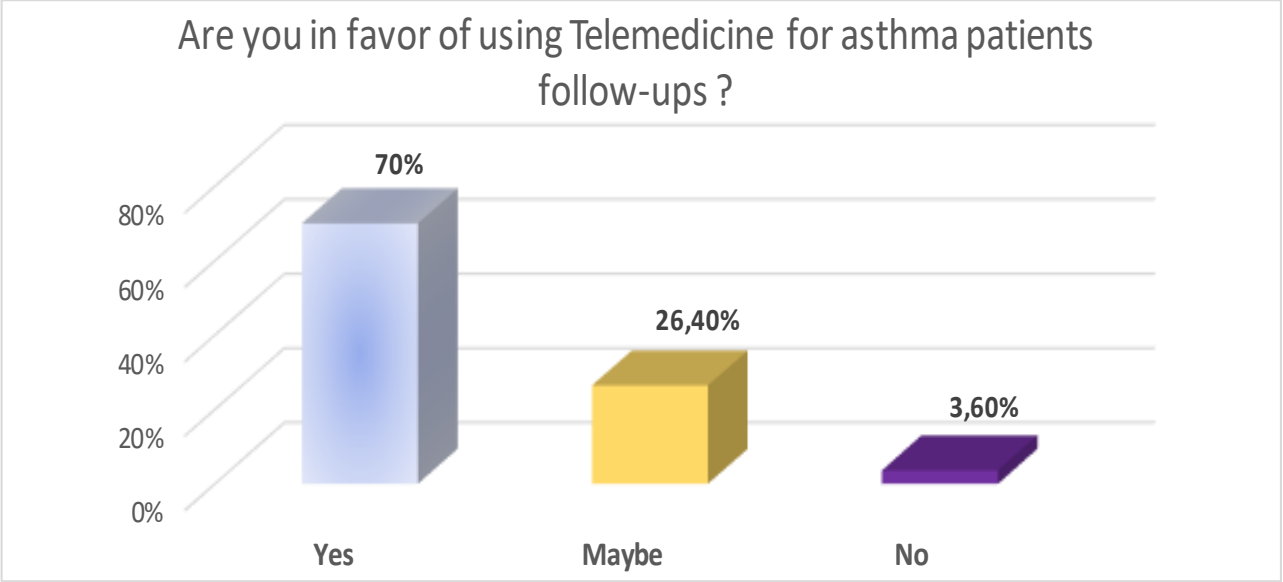

Figure 12: Evaluating Practitioners Support for Telemedicine in Asthma Follow-Ups.

2. Types of Asthma Patients Suitable for Remote Monitoring:

Participants who responded positively to the preceding question were subsequently asked to specify which types of asthma patients they perceive as suitable for telemonitoring (multiple choices were permitted). A total of 241 participants provided responses. Of these, 224 (92.9%) chose "controlled asthma", while 138 (57.3%) selected "partially controlled asthma". And only 28 (11.6%) participants chose "uncontrolled asthma".

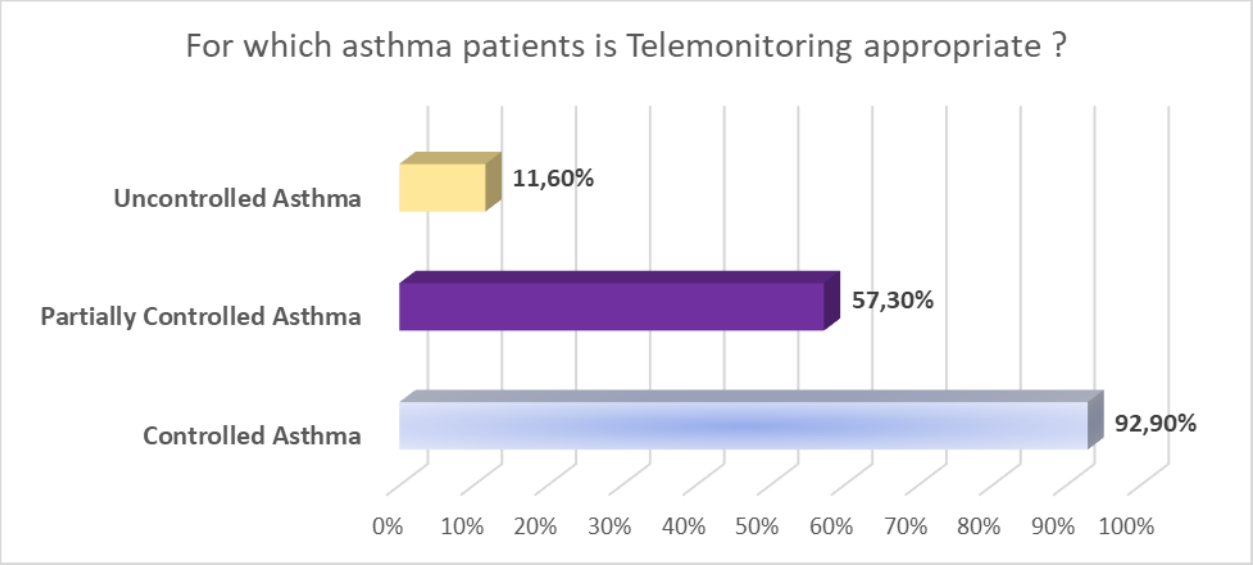

Figure 13: Telemonitoring Suitability by Asthma Control Level: Practitioners' Insights.

3. Coordination of Telemedicine Appointments:

When physicians were surveyed regarding who they believed should be responsible for managing telemedicine appointment logistics, the responses indicated a slight preference for third-party involvement, with 146 physicians (58.4%) supporting this option. In contrast, 104 physicians (41.6%) believed that the primary care physician should take on this responsibility.

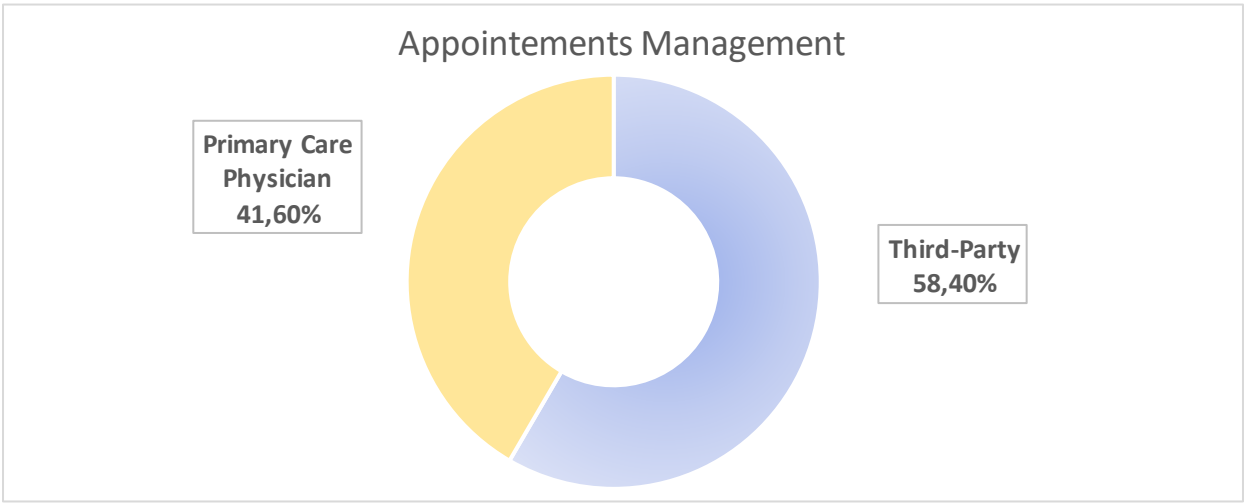

Figure 14: Responsibility for Managing Telemedicine Appointment Logistics.

4. Frequency of Telemedicine Follow-ups:

Regarding the appropriate frequency for scheduling telemedicine appointments for asthma patients, physicians expressed their preferences as follows:

- For "Controlled asthma", quarterly appointments were the most favored option, receiving 147 votes (58.8%).
- For "Partially controlled asthma", monthly check-ins garnered 140 votes (56%).
- In the case of "Uncontrolled asthma" ,130 physicians (52%) supported a weekly appointment frequency, while 109 physicians (43.6%) indicated that daily appointments would be necessary.

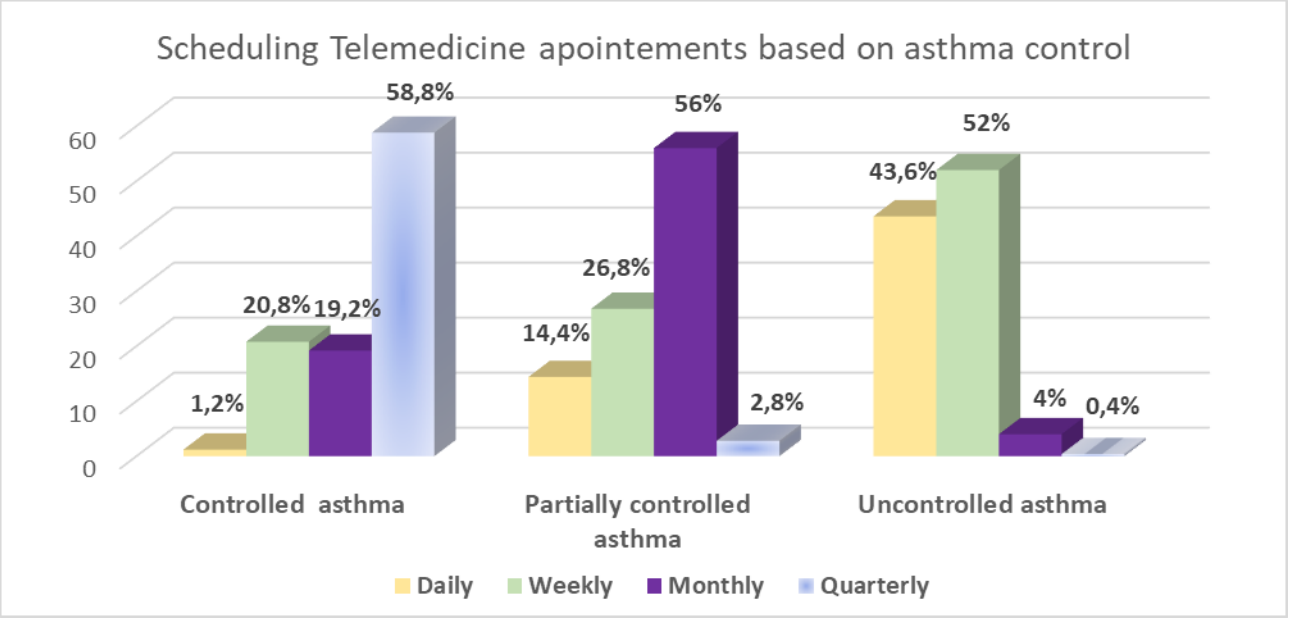

Figure 15: Frequency of Telemedicine Visits by Asthma Control Level.

5. Perceived Functionality of Telemedicine in Asthma Monitoring:

In terms of the utility of telemedicine in remote monitoring of asthma patients, physicians prioritized two propositions with closely related percentages (multiple choices were permitted):

- Therapeutic education for patients (232 responses, 92.8%).
- Monitoring adherence to treatment (229 responses, 91.6%).

As secondary applications, many emphasized:

- Managing exposure to risk factors, such as allergies, infections, and professional environments or athletic activities (192 responses, 76.8%).
- Evaluating asthma control (190 responses, 76%).

Finally, only 88 respondents (35.2%) supported:

- The adjustment of treatment based on the degree of asthma control, implying that many physicians are inclined to make these decisions during in-person consultations.

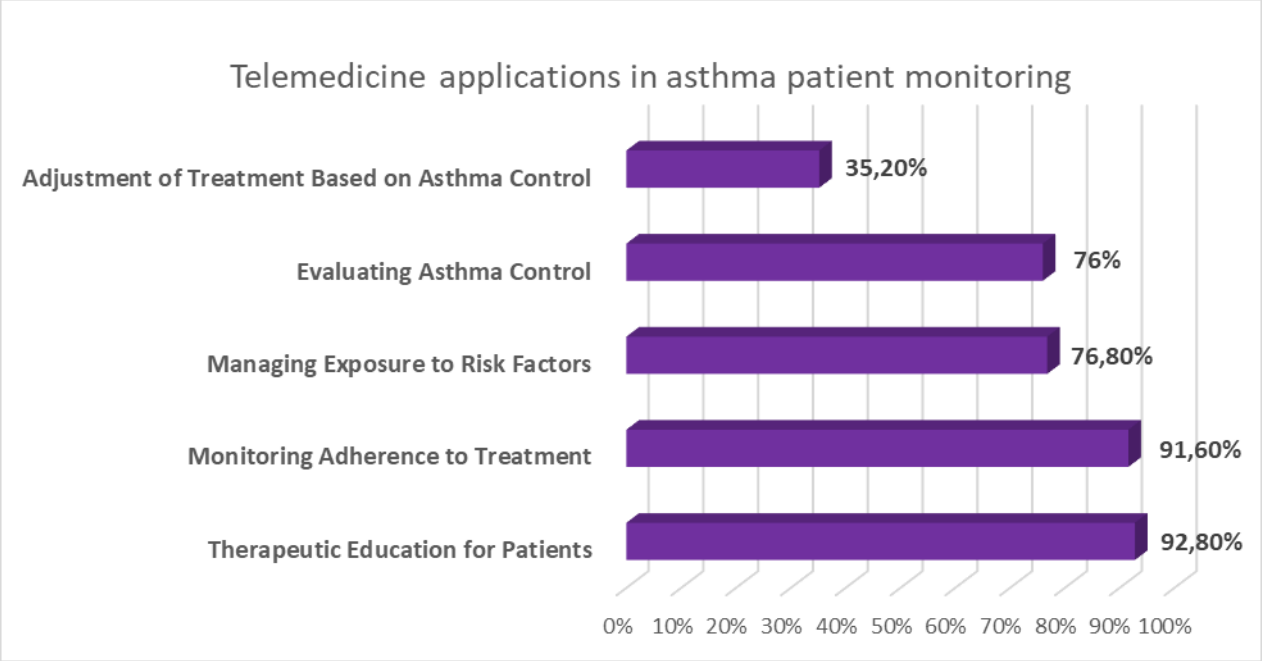

Figure 16: Use of telemedicine in asthma patient monitoring.

IV. Training and Preparation:

1. Need for Specialized Training in Telemedicine:

The majority of physicians acknowledge the need for specialized training for healthcare professionals involved in asthma management via telemedicine. This is reflected in the responses, with 238 participants (95.2%) supporting the need for mentoring, while only 12 participants (4.8%) indicated otherwise.

Figure 17: Advocacy for Specialized Training for physicians.

2. Suggested types of Training:

Among the 238 practitioners who acknowledged the need for training to refine their proficiency in telemedicine, the following types of training were selected with comparable levels of preference (participants could choose multiple options):

- Simulation sessions (189 responses, 79.4%).
- Webinars (174 responses, 73.1%).
- A detailed guideline/manual for physicians (168 responses, 70.6%).

In contrast, "in-person training" was rated lowest, garnering only 82 votes (34.5%).

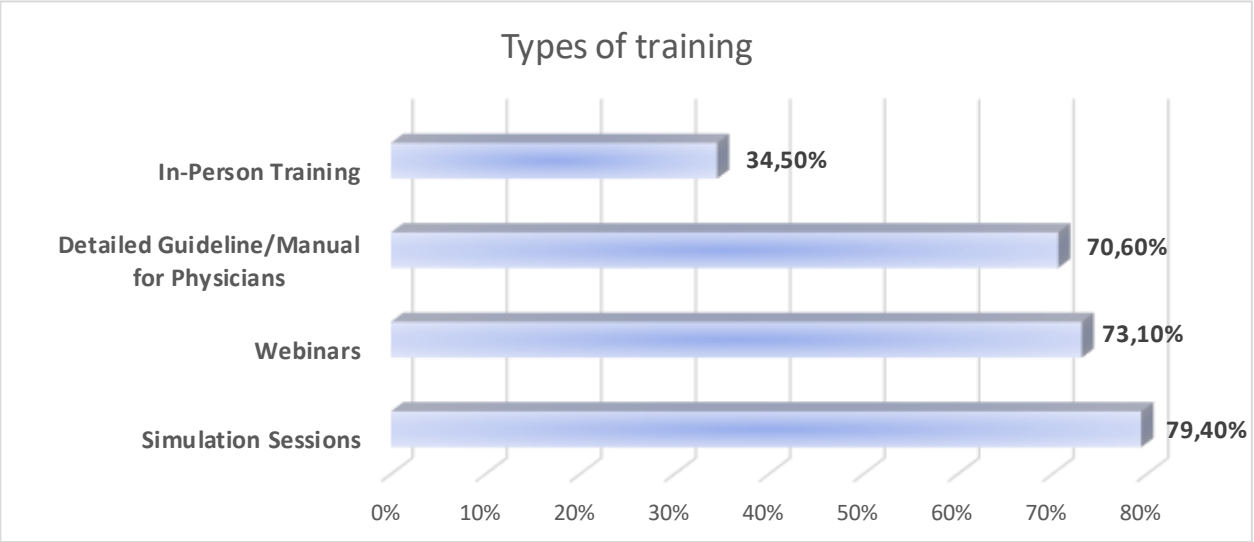

Figure 18: Preferred Training Methods for Telemedicine Practitioners.

V. Tools and Technologies:

1. Preferred Telecommunication Methods:

Regarding the preferred modalities/tools for telecommunication with patients, respondents were allowed to make multiple selections. Video calls emerged as the most favored method, with 208 responses (83.2%). This was followed by Mobile applications and sites (133 responses, 53.2%) and Voice calls (99 responses, 39.6%). Notably, messaging ranked last, receiving only 46 responses (18.4%), which may indicate a perception among healthcare providers that text-based communication lacks the immediacy and clarity of other methods.

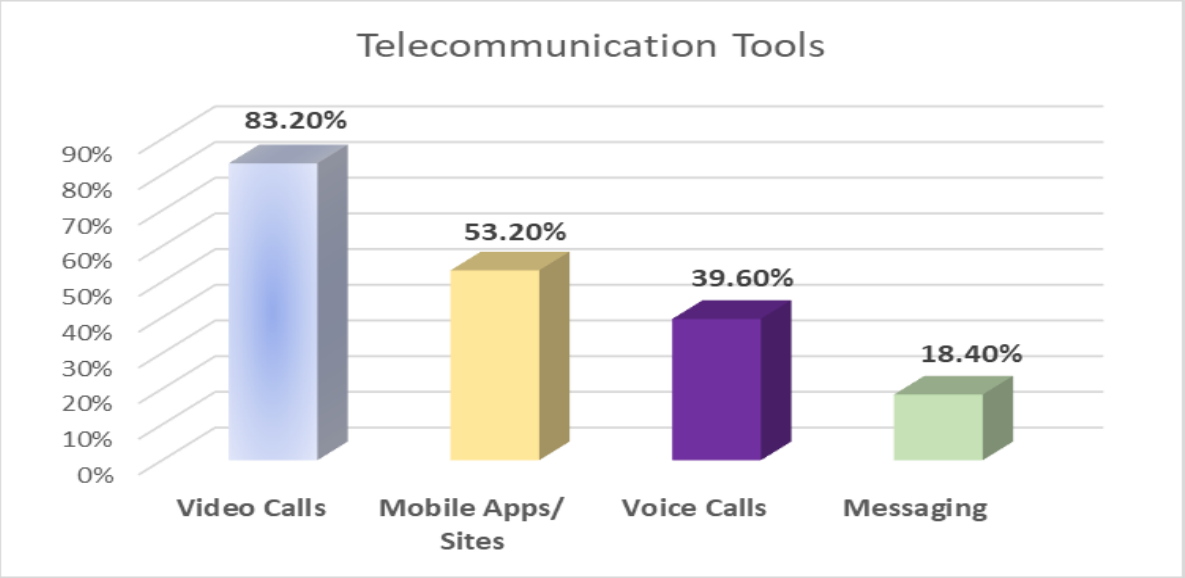

Figure 19: Favored Telecommunication Methods with Patients.

2. Recommended Duration for Remote Consultations:

When asked about the estimated duration deemed necessary and sufficient for a remote consultation, there was a predominance of 176 participants (70.4%) who selected 15-20 minutes, while 70 participants (28%) suggested 20-30 minutes. Only 4 respondents (1.6%) felt that a longer duration of 30-40 minutes was necessary for a teleconsultation.

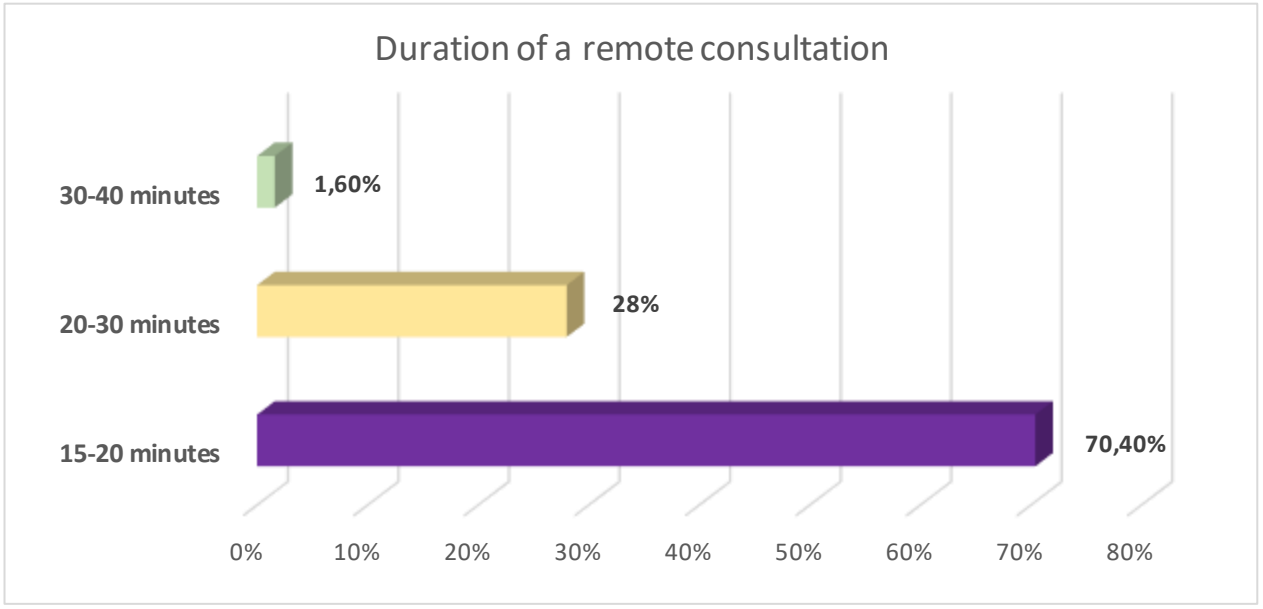

Figure 20: Preferences on estimated duration for remote consultations.

VI. Remuneration for Telemedicine Services:

1. Consensus on Compensation for Telemedicine Consultations:

A substantial majority of practitioners, totaling 243 respondents (97.2%), affirm that compensation for telemedicine consultations is essential. This strong consensus highlights the recognition of telemedicine as a legitimate and vital component of healthcare delivery. In contrast, a small minority of 7 respondents (2.8%) do not support this viewpoint.

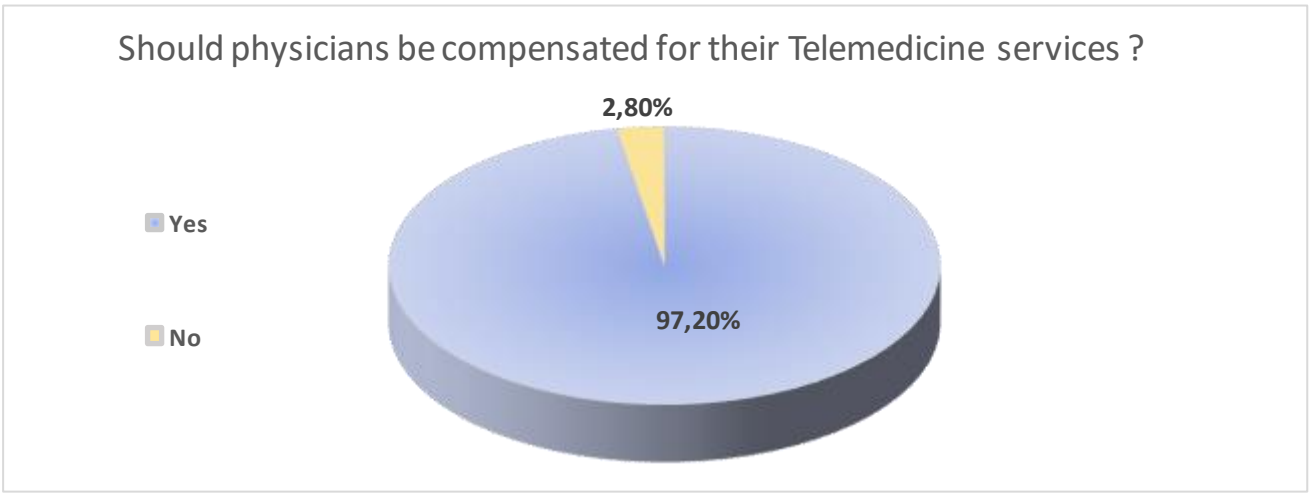

Figure 21: Views on payment for physicians providing Telemedicine services.

2. Appropriate Compensation Standards:

Among the respondents who supported payment for telemedicine consultations, opinions varied regarding the appropriate compensation rate. A significant majority of 139 (57.21%) participants believed that it should be equivalent to that of a traditional consultation, reflecting a strong desire for parity between the two modalities. While 84 (34.56%) felt it should be lower, and only 20 (8.23%) argued for a higher rate than in-person consultations.

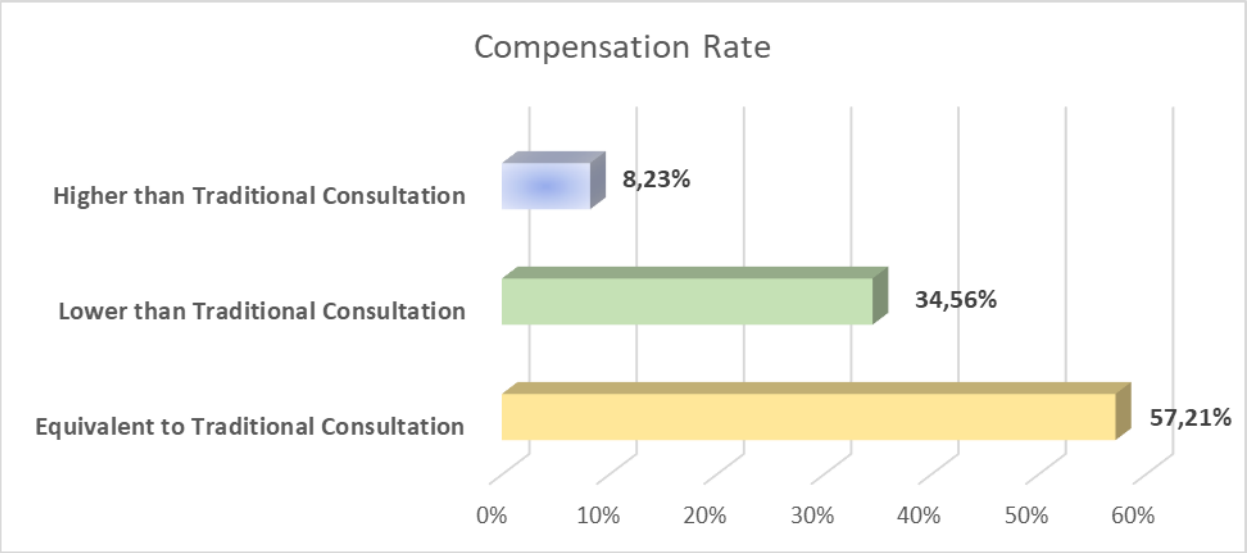

Figure 22: Opinions on renumeration rate for Telemedicine Consultations.

3. Insurance Coverage for Telemedicine:

In response to the question of whether health insurance plans should cover teleconsultations, a clear majority of participants (222 individuals, representing 88.8%) affirmed that they believe teleconsultation should be included in their coverage. This overwhelming support suggests a strong recognition of the value of telemedicine in enhancing accessibility and convenience for patients. In contrast, 28 respondents accounting for (11.2%), expressed dissent.

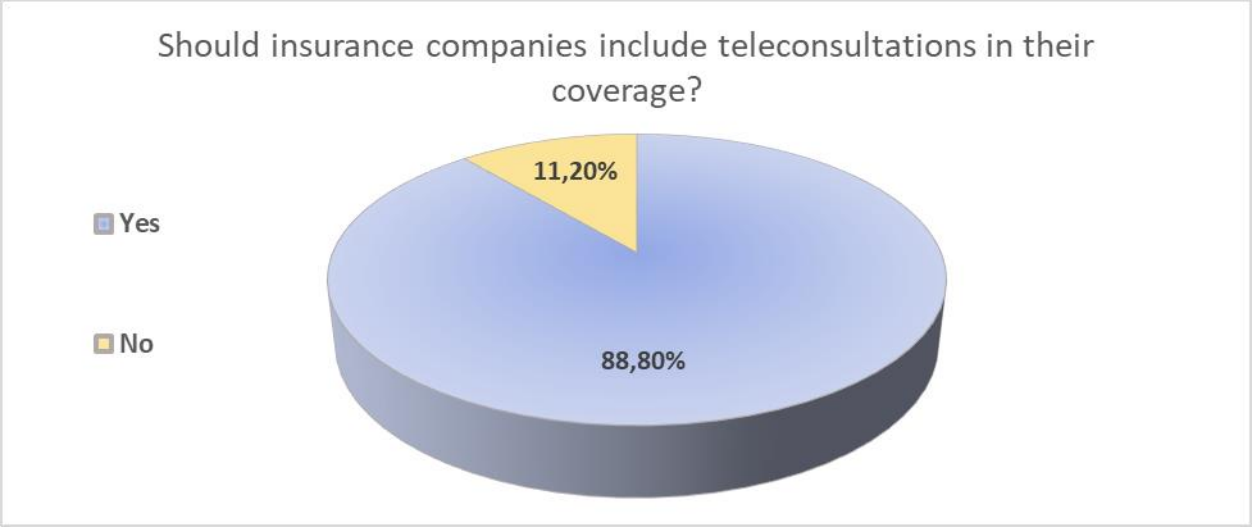

Figure 23: Support for Teleconsultation Coverage by Health Insurance Plans.

VII. Additional feedback: "Suggestions and comments verbatim":

The final question of the survey invited open-ended suggestions or comments on optimizing asthma management through telemedicine. We received ten responses, summarized as follows:

- *"Create a patient database to allow the consulting physician easy access to the patient's record to better evaluate asthma progression and ensure better management".*
- *"Many patients cannot afford to come for consultations. If teleconsultations were cheaper and more accessible, we could reach a larger demographic of asthma patients".*
- *"Establish specific applications with identifiers for both patients and physicians, tailored to their schedules so that patients can benefit from adequate teleconsultations".*
- *"Continuous and real-time monitoring, online education programs for patients".*

- *"Implement a mobile application where patients could record their daily symptoms, triggers, and medication use, helping doctors adjust treatments. Additionally, connect the app to spirometers or pulse oximeters to measure lung function and automatically send data to the treating physician for real-time analysis".*

- *"Raise public awareness about using telemedicine".*

- *"Integrate explanatory videos and infographics to better inform patients; we can send reminders for medication adherence, follow-up consultations, and paraclinical tests".*

- *"How can we compensate a physician practicing in the public sector?"*

- *"Telemedicine must complement traditional in-person consultations"".*

- *"The management of asthma or other conditions via telemedicine should be optional, not official, as nothing surpasses a clinical examination and direct contact with the patient".*

DISCUSSION

I. Introduction to Telemedicine:

1. Brief History of Telemedicine:

Telemedicine owes its existence to a long history of technological innovations that have progressively transformed healthcare delivery over the last two centuries. Each step in this evolution has contributed to the broader accessibility and sophistication of telemedicine, fundamentally reshaping the way healthcare is delivered internationally.

Antiquity Greece, Rome and Egypt (500 BCE - 500 CE):

Some trace the origin of telemedicine as far back as the use of scrolls and hieroglyphs by the ancient Greek, Roman, and Egyptian civilizations. In a similar vein, early methods of sharing health-related information also included practices like using bonfires to signal outbreaks of illness.(5)

In ancient times, physicians Including the renowned Hippocrates and his followers relied on written messages to share medical knowledge. These writings, which often contained instructions for the treatment of common illnesses and guidelines for medical practice were copied and distributed to other medical practitioners, effectively serving as early forms of telecommunication. While this was not "telemedicine" in the modern sense, it laid the foundation for knowledge-sharing across distances fostering the spread of medical practices and the establishment of standardized care.(6)

1850-1900: Early Communication Devices:

The telegraph, often called "The Victorian Internet," a groundbreaking invention that revolutionized long-distance communication. Developed in 1837 by American inventor Samuel Morse, with assistance from Alfred Vail, it paired with the Morse code a system of short and long dashes (figure 1) representing letters and numbers. This technology enabled messages to be transmitted over long distances via electrical impulses. In the 1860s, during the American Civil War, the telegraph was used to send reports on wounded soldiers to waiting medical teams, marking its first use in distant medical care.(7)

Figure 24: The Telegraph and international morse code, Earliest device used in telemedicine communication "File: Morse Telegraph 1837.jpg"(8).

Following the invention of the telegraph, major devices such as the radio and telephone were developed. The use of radio for medical consultations was explored in Europe, Australia, and North America, primarily to provide healthcare to ship crews. Notable examples of this include the Centro Internazionale Radio Medico (CIRM) in Italy and the Aerial Medical Service in Australia, both of which facilitated medical consultations via radio.(9)

1900-1970: Early innovations in Telemedicine:

In the early 20th century precisely in “1905”, William Einthoven developed the first electrocardiogram and successfully transmitted both the “TeleECG” and heart sounds between his lab and an academic center. This early use of telemedicine highlighted the potential of remotely transmitting critical medical data, marking a milestone in the evolution of healthcare.(10)

Gerson Cohen coined the term "Telognosis" (now teleradiology) to describe the diagnostic use of transmitted radiographs via radio or telephone. He documented a three-year study in which radiographs were transmitted over commercial telephone lines between a clinic in Atlantic City and a hospital in Philadelphia, 60 miles away. Cohen highlighted the value of telemedicine in offering expert training to young radiologists and ensuring continuous radiologic services for smaller hospitals.(11)

With the rise of television, it became a tool for clinical care, medical education, and showcasing surgical procedures. A prominent example was the "Blue Baby Operation" at Johns Hopkins Hospital, performed by Dr Alfred Blalock, which was broadcast via closed-circuit television to an audience of hundreds of surgeons.(9)

The first use of interactive video communication in healthcare occurred in the late 1950s, when the Nebraska Psychiatric Institute conducted a psychiatric teleconsultation with Norfolk Hospital, located 112 miles away, via an interactive television system. Another experimental project was initiated in 1959 in Canada by a radiologist, enabling the transmission of images over coaxial cable for remote diagnostics.(12)

1970-2000: Development of Telemedicine:

The 1970s saw key innovations in connectivity and devices that established the foundation for modern telemedicine. The term "telemedicine" was coined by Bird. In 1974, Murphy and Bird published a large-scale Telediagnosis study involving 1,000 patients, connecting the emergency ward of Massachusetts General Hospital with the Logan International Airport medical station in East Boston. Using television and audiovisual circuits, they demonstrated the feasibility of real-time remote patient examinations.(9)

Telemedicine got further boost from advances in space technology and its application to promote access to healthcare in rural areas. In 1975, NASA launched the STARPAHC (Space Technology Applied to Rural Papago Advanced Health Care) project to improve healthcare delivery in Indian reservations. The system used two-way communication via television, radio, and remote telemetry between an Indian Health Service hospital and a mobile health unit staffed by nurses and advanced practice providers.(13)

In 1977, Grundy reported the first synchronous telemedicine network connecting University Hospital in Cleveland with Forest City Hospital, providing critical care and newborn nursery rounds remotely. He concluded that audiovisual links could effectively support regular critical care consultations.(14)

A giant leap in connectivity was made with the development of ARPANET (Advanced Research Projects Agency Network), initially designed to link mainframe computers in Department of Defense facilities across the USA. This technology evolved into the modern internet by the late 1990s, becoming publicly accessible and pivotal in shaping the growth of telemedicine in the following years.(15)

The most important event in telemedicine may be the introduction of Video Teleconferencing (VTC) systems, originally designed for business meetings. Though not initially intended for healthcare, VTCs were quickly adapted to facilitate remote consultations .These systems were integrated with medical devices, such as electronic stethoscopes and endoscopes, enhancing their diagnostic capabilities and expanding telemedicine's reach.(16)

2000-2020: Technological Revolution:

The past two decades saw rapid advancements in technology, including smartphones, tablets, telemedicine devices, and improved connectivity via cellular and broadband networks. The smartphone revolution enabled consumers to access healthcare through mobile apps, leading to the rise of companies like "**Teladoc Health®**". As one of the largest U.S. telehealth providers, Teladoc provides 24/7 access to physicians, offering consultations for minor illnesses via phone or video consultations. In 2013, Teladoc served over 6 million members and handled more than 120,000 consultations. It has become a growing alternative for convenient, after-hours care.(17)

In 2015, a study conducted by the Robert Graham Center, found that while most physicians viewed telehealth as a promising tool for improving patient access to primary care, only 15% of the 1,557 physicians surveyed had adopted telemedicine in their practices. This indicates that, despite its potential, telemedicine had not yet achieved widespread implementation and required further development for broader adoption.(18)

2020-Present: Impact of the COVID-19 Pandemic:

The World Health Organization (WHO) declared the SARS-CoV-2 (COVID-19) outbreak a public health emergency on January 30, 2020, and a pandemic on March 11, 2020. Telemedicine became a crucial tool during the pandemic for enhancing epidemiological control and managing clinical cases. It enabled the triage of suspected COVID-19 cases, monitoring of asymptomatic or mildly symptomatic patients, and identification of those needing hospitalization. Furthermore, telemedicine allowed mildly infected healthcare providers to continue their practice from home, ensuring continuity of care for chronic conditions across various specialties.

In the United States, telemedicine consultations surged from 13,000 per week to 1.7 million per week after the pandemic began. Meanwhile, in North Africa, despite accounting for 24% of the global disease burden, the region faces significant disparities in healthcare resources, with only 3% of the world's health workforce and less than 1% of global health expenditures. This gap highlights the challenges of providing adequate healthcare in the region. The COVID-19 pandemic further exposed the urgent need to integrate telemedicine into Africa's healthcare system, but significant barriers remain to its implementation.(19)

Since 2020, telemedicine has expanded to integrate a wide range of services, allowing patients to share real-time health data with their primary care physicians. Telemedicine platforms now offer specialized services, for instance, tracking chronic conditions with the assistance of Connected Health sensors. Asynchronous methods include remote patient monitoring (RPM), mobile health (mHealth) applications, and the use of e-consults in various medical specialties .Notably, Specialists with the highest use of TM were radiologists, primarily due to their use of asynchronous store-and-forward method.(20)

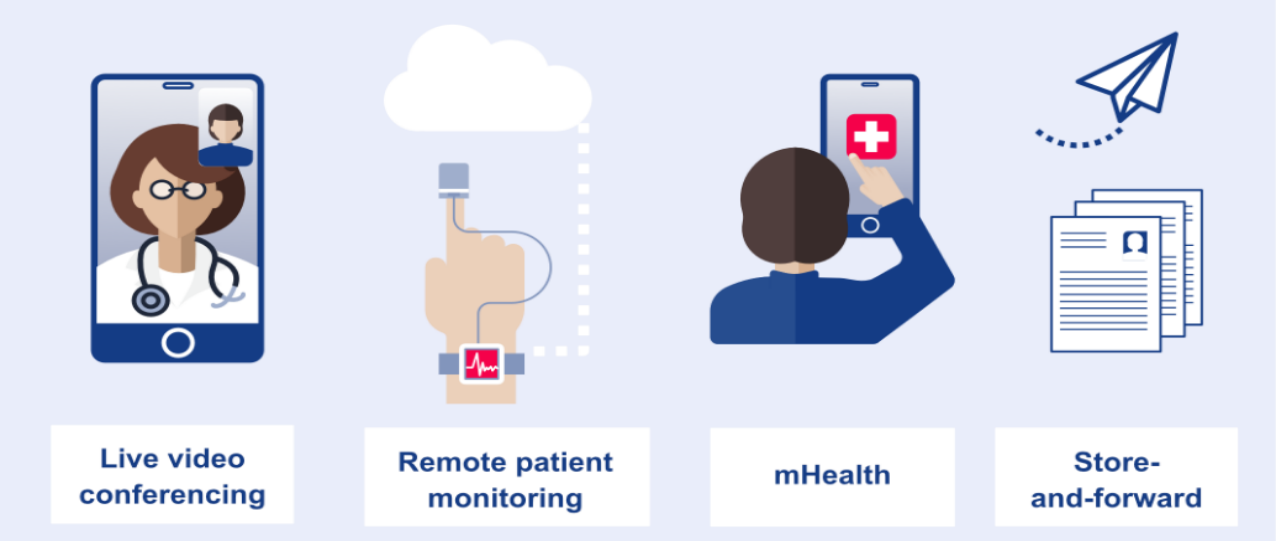

Figure 25: Emerging Models for Telemedicine Service Delivery.(21)

Legal and regulatory changes have played a crucial role in this growth. Many countries have implemented policies that enhance telemedicine reimbursement, expand insurance coverage, and establish clearer standards for cross-border telehealth services, such as the ATA's (American Telemedicine Association) "Standard of Care in Telehealth"; a one-pager that ensures that patients receive equivalent quality of care, regardless of the delivery method.(22)

History of Telemedicine in Morrocco:

Although exact data on the advent of telemedicine in Morocco is limited, several notable examples highlight its early adoption:

The Faculty of Medicine of Marrakech (FMPM) has been using a videoconferencing system since 2002, supported by ISDN (Integrated Services Digital Network) technology. This system facilitates remote medical case discussions and educational exchanges. A significant example of its use was a 2004 conference involving three locations: the Faculty of Medicine of Marrakech, the Faculty of Medicine of Casablanca, and the University of Toulouse, chaired by Professor Louis Lareng, focusing on the reform of medical education.(23)

In 2007, a partnership agreement between the Lalla Salma Foundation and the Brussels Cancer Screening Centre was established, leading to the creation of a telemammography screening program. This initiative aimed to enhance access to breast cancer screening through innovative technology.(24)

On November 15, 2007, the Children's National Medical Center (CNMC) in Washington, D.C. provided a satellite-based videoconferencing system to FMPM. This system enabled the pediatric cardiovascular surgery team at FMPM to conduct multidisciplinary teleconferences on congenital heart disease cases in children. These sessions began on July 24, 2009, and have become regular, weekly events since 2014. They now form an essential part of teleconsultations, tele-expertise, and continuous medical education.(25)

The Mobile Health Tuberculosis Project, launched in March 2014 in the Salé province, with the Korean cooperation and the Moroccan Anti-Tuberculosis Association, introduces an innovative approach to tuberculosis treatment. It provides patients with a smart box designed to detect those who discontinue their treatment.(24)

On September 30, 2014, University Consultation Center in the UH Ibn Sina in Rabat, carried out its first telemedicine consultation. A Moroccan surgical team connected directly with a Belgian team, led by Tim Tollens, to ask questions about specific laparoscopic surgical techniques. This marked a significant moment for telemedicine in Morocco, facilitating direct communication and knowledge exchange between healthcare professionals from different countries.

The Marrakech-Safi region launched a telemedicine project aimed at improving access to healthcare. A regional agreement was signed between key partners, including the Marrakech-Safi Regional Council, the Regional Directorate of Health and Social Protection, the Mohammed VI University Hospital in Marrakech, and the Faculty of Medicine and Pharmacy of Marrakech. The project, which covers areas such as Al Haouz, Chichaoua, El Keaa, Essaouira, Marrakech, Rehamna, Safi, and Youssoufia, aims to expand telemedicine services and improve healthcare delivery across the region.(23)

The Moroccan Society of Telemedicine (SMT), founded in June 2018, under King Mohammed VI's patronage, aims to expand telemedicine in rural areas. By establishing infrastructure and promoting adoption among healthcare professionals, the SMT will equip pilot sites in regions like Midelt and Taroudant to offer teleconsultations, reducing health disparities between urban and rural populations.(26)

More recently in February 2024, a Telemedicine cabin" Mediot" (Figure 26) was installed at the FMPM. This setup features advanced technology, including high-definition video conferencing systems, medical sensors for vital sign monitoring, and secure data transmission capabilities. Currently, it is being utilized for educational simulations across various themes. This initiative not only enhances the learning experience but also prepares future healthcare professionals to engage in remote patient care.

Figure 26: Photographs taken of the "Mediot" telemedicine cabin in the multimedia room at the Faculty of Medicine and Pharmacy of (FMPM).

2. Definition of Telemedicine:

The World Health Organization (WHO) defines telemedicine as the provision of healthcare services in which distance is a significant factor. This practice involves healthcare professionals utilizing information and communication technologies to exchange valid information pertinent to the diagnosis, treatment, and prevention of diseases and injuries. Additionally, telemedicine encompasses research, evaluation, and ongoing education for healthcare providers, all aimed at improving the health of individuals and their communities.(27)

The World Health Organization does not distinguish between telemedicine and telehealth; therefore, these terms may be used interchangeably in this study.(28)

↳ Definitions of Telemedicine services:

Figure 27: Telemedicine services.(21)

Teleconsultation: This involves real-time communication between healthcare providers and patients or between providers themselves. It can be synchronous (live video calls) or asynchronous (messages or recorded videos). Teleconsultation is often used for follow-up visits, routine check-ups, or specialist consultations.

Telemonitoring: This allows healthcare professionals to remotely analyze and interpret patients' health data, focusing on continuous monitoring, particularly for chronic disease management. Devices collect vital data (ECG, blood pressure, glucose levels, heart rate…) that can be transmitted automatically or manually by the patient for timely interventions.

Tele expertise: This enables a medical professional to seek the opinion of one or more specialists remotely, to discuss specific medical information related to a patient's care.

Telediagnosis: Determining the nature of a patient's disease, at a remote location, based on the clinical data and information (images and video records), transmitted via communication technologies.

Tele screening: Uses information and communication technologies to remotely identify undiagnosed or pre-symptomatic diseases in individuals without evident symptoms, through medical tests conducted at a distance.(21)

Telepathology: This specialized field involves the remote diagnosis of diseases by examining pathology slides through digital imaging, allowing pathologists to collaborate and share images for accurate diagnoses without physical presence.

Teleassistance: This permits a medical professional to provide remote assistance to another healthcare provider during a medical procedure.

Tele-education: This involves the use of telemedicine technologies to educate patients about their health conditions, treatment options, and self-management strategies. It can include webinars, online courses, or one-on-one sessions with healthcare professionals.

Tele triage: This is a process where healthcare professionals assess a patient's condition remotely to determine the urgency of their needs. It helps prioritize care and direct patients to the appropriate level of service, whether that be immediate care, a teleconsultation, or an in-person visit.

Tele-manipulation: The use of remote control/video devices, robots and sensors in examination or intervention (Tele-endoscopy, Tele-sonography…).

Telesurgery: The Use of telemedicine equipment, information and communication technologies to support and monitor surgical procedures at a distance ,or to perform remote surgery with robotized computerized machines and devices.(29)

3. Overview of Telemedicine Tools:

Telemedicine tools encompass both software applications and hardware gadgets:

- **Software:** Apps and Platforms accessible via main vendors (Google, Apple and Android) like: **Amwell ®, Doxy.me®, DabaDoc®, Odocteur®, e-Santé®, and tbib24®,** that allow key Features:
  - **Video Consultations:** Secure video conferencing capabilities for real-time interactions.
  - **Secure Messaging:** Encrypted communication channels for messaging between patients and providers, utilizing the store-and-forward method to capture and transmit medical information securely for later review and analysis.
  - **EHR Integration:** Seamless integration with electronic health records for efficient patient management.(30)
  - **Appointment Scheduling:** Tools for managing patient appointments and reminders.
  - **Data Analysis:** Data collected from wearables can be transferred initially to a computer or smartphone before being securely processed through a centralized server, which either uses its own programs and technology or, more recently, leverages AI algorithms. ena-bling healthcare providers to analyze patient information for improved care delivery.(31)

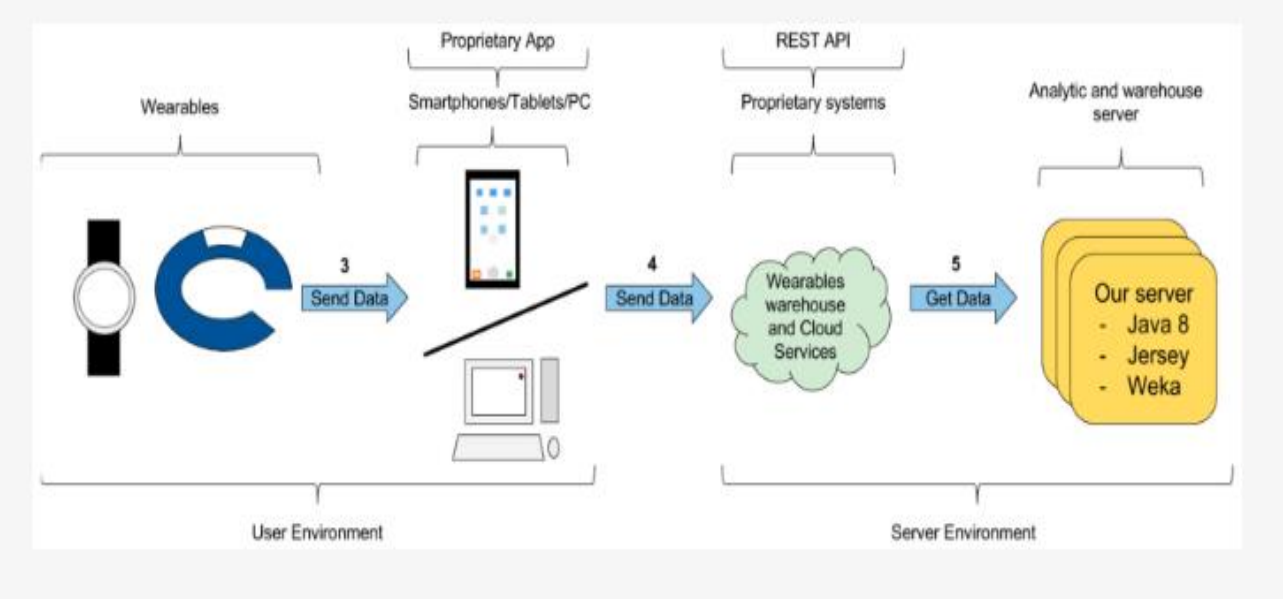

Figure 28: System representation of Data collection and analysis steps.(31)

- **Gadgets and Devices:**

Table III: Overview of Remote Monitoring and Telehealth Devices:

Wearable Devices	Smartwatches and fitness trackers that monitor vital signs, such as heart rate and oxygen saturation, as well as sleep quality.(32)
Remote Monitoring Tools	○ Pulse Oximeters, ○ Blood Pressure Monitors ○ Continuous Glucose Meters (CGM) ○ ECG, EEG, and EMG sensors ○ Cardiac telemetric devices ○ Accelerometers ○ Smart Inhalers ○ Remote Capnography Devices ○ Remote Fetal Monitors ○ Smart beds…etc (33)
Telehealth Kits	For remote examinations and treatment, such as: ○ Remote Stethoscopes ○ Otoscopes ○ Digital Thermometers ○ Dermatoscopes ○ Spirometers and Digital peak flow meters ○ Connected Nebulizers ○ Smart weight scales ○ Remote Ultrasound Devices ○ Portable Blood Analyzers (including Anticoagulation testing devices) ○ Smart Pill Dispensers ○ Handheld Retinal Cameras ○ Connected contact lenses ○ Smart Insulin Pens and Pumps…etc (34)

Figure 29: Smart Wearables: Enhancing Remote Health Management.(21)

4. Telemedicine Applications Across Various Specialties:

Telemedicine is increasingly employed across various medical specialties, improving patient care and access to specialists. Here are some key examples of its applications:

a. Pulmonology:

Teleconsultations: allow pulmonologists to evaluate patients remotely through video conferencing, using Platforms like **Teladoc®, Amwell®** to discuss symptoms, and medication adjustments. This is particularly beneficial for patients with chronic respiratory conditions who may have difficulty traveling to appointments.(35)

Remote Patient Monitoring (RPM): particularly used for patients with COPD or asthma, it involves the use of devices that monitor patients' respiratory health metrics in real-time, and transmit the data to healthcare providers. With Gadgets like:(36)

- **Pulse Oximeters**: Devices like the **Masimo MightySat®** or **Wellue O2Ring®** measure blood oxygen saturation and heart rate.
- **Spirometers**: Devices such as the **MIR Spirobank®** or **CareFusion's Vitalograph®** measuring various parameters such as forced vital capacity (FVC) and forced expiratory volume (FEV1), allows patients to perform spirometry tests at home and send results to their physician.(37)
- **Smart Peak Flow:** to track peak expiratory flow (PEF) levels.
- **Smart Inhalers**: Devices like the **Propeller Health inhaler ®** that can track usage, providing feedback to both patients and providers.(38)

Figure 30 : Telehealth tools in respiratory illness care.(39)

Tele-education and Self-Management Programs: Telemedicine facilitates educational programs that empower patients to manage their respiratory conditions effectively, helping them learn about triggers, medication techniques, and lifestyle modifications.

- **Online Workshops:** like "Breath Easy Program" that offers virtual workshops on asthma and COPD management.(40)
- **Mobile Apps**: such as **Smart Asthma ™** and **Find Air ™** ,provide educational resources, medication reminders, and symptom tracking.(41)

Tele-therapy and Rehabilitation: inadequate control of bronchial inflammation in asthmatic patients over the long term can lead to irreversible bronchial-wall remodeling, consequent loss of airway elasticity and, thereby, permanent reduction in lung function (42).Therefore, remote pulmonary rehabilitation programs can help improve the physical and mental well-being of patients with chronic lung diseases.

- **Rehabilitation Platforms**: Programs like "Lung Fit" provide structured rehabilitation exercises and advice from a respiratory therapist.(43)
- **Wearable Devices**: Such as **Fitbit®** or **Apple Watch®** can track physical activity and respiratory rates, which can be monitored by healthcare providers.(44)

Chronic Disease Management: supporting ongoing management of chronic respiratory diseases like interstitial lung disease to monitor its progression and medication side effects by facilitating regular check-ins and monitoring.(45)

Telemedicine in Sleep Studies: Telemedicine has significantly improved the management of sleep disorders like Obstructive Sleep Apnea (OSA) by facilitating consultations, diagnosis, and treatment at home.(46)

- **Home Portable Sleep Monitors**: These devices often use sensors to measure oxygen levels, heart rate, airflow, and respiratory effort. They provide clinical-grade data for healthcare professionals. Such as the **WatchPAT®** or **ApneaLink®** used to diagnose sleep disorders, like sleep apnea.
- **Wearable Devices**: Smartwatches or fitness trackers (**Oura Ring®**), that estimate sleep stages and duration along with other health metrics.(47)
- **Sleep Tracking Apps**: like **Sleep Cycle®** or **Pillow™** , they primarily use the phone's microphone to capture sounds (e.g., snoring or movement) or accelerometer data to estimate sleep patterns and provide insights into sleep quality.(48)

Integration with Electronic Health Records (EHR): Telemedicine platforms often integrate with EHR systems, allowing for seamless data sharing and documentation, providing easy access to medical history. This is particularly beneficial for asthma patients, as it enables practitioners to monitor long-term trends in their condition, such as exacerbation frequency or medication adherence, and make timely adjustments to their treatment plans. (49)

b. Emergency care:

Tele triage: The Initial Assessment allows emergency departments professionals to evaluate the urgency of a patient's condition via video, phone consultations or platforms like: **Doctor on Demand®**, **MDLive®**. This helps prioritize cases and manage patient flow effectively.(50)

Specialist Consultation: Emergency physicians can consult with specialists remotely through platforms like " **Zoom** ®" for Healthcare, to obtain expert opinions on complex cases. (51)

Follow-Up Care: Patients discharged from the ED can have follow-up remote consultations, to monitor their recovery and address any concerns, ensuring continuity of care.(52)

Disaster Response and Public Health Emergencies: In situations like natural disasters or pandemics, this is crucial for maintaining healthcare access when traditional services are disrupted, as well as providing medical logistics coordination.(53)

Access in Out-of-Hospital and Resource-Limited Settings: It extends specialist care to patients in areas with limited healthcare resources.(54)

Remote Patient Monitoring (RPM): enables continuous monitoring of patients' vital signs and health metrics, allowing for timely interventions, if any concerning trends are detected.

- **Devices**: **Apple Watch ®, Fitbit ®,** and **Garmin ®** can monitor heart rate, oxygen saturation, and activity levels, plus digital thermometers, and electronic stethoscopes.(55)
- **Remote Monitoring Systems**: **Biotelemetry ®** and **Vital Connect ®** provide real-time data transmission to healthcare providers.(56)

Telehealth in Trauma Care: can be utilized in trauma situations to provide immediate guidance to on-site emergency responders, during a mass casualty incident, paramedics can use telehealth technologies to consult with trauma surgeons in real-time, ensuring that patients receive appropriate care before arriving at the hospital.(57)

Telehealth for Mental Health Emergencies: provides immediate access to mental health professionals for patients in distress, such as crisis intervention Platforms: **Talkspace ®**, and **BetterHelp ®**.(58)

c. Cardiology:

Remote Monitoring: Patients with heart conditions can use wearable or implantable devices, such as ambulatory monitors, pacemakers, and implantable cardioverter defibrillators (ICDs), to track heart rate, rhythm, and blood pressure 24/7. Data from these devices can be transmitted to cardiologists for real-time assessment and early detection of conditions such as atrial fibrillation or any other acute issues.(59)

Teleconsultations: can be used for follow-up care, medication management, and lifestyle counselling, and chronic disease management (hypertension, diabetes, heart failure…).

Telerehabilitation: Telemetric devices can document physical activity and clinical visits, enabling healthcare providers to intervene if risk factors do not meet guideline-recommended targets. This is particularly important for acute cardiac rehabilitation in survivors of acute coronary syndrome.(60)

d. Endocrinology:

Diabetes Management: Telemedicine enables endocrinologists to remotely monitor patients' blood glucose levels, using real-time continuous glucose monitoring (RT-CGM) devices and adjust insulin dosages as needed. Patients can also receive education on diet and lifestyle changes. According to the 2022 Standards of Medical Care from the American Diabetes Association (ADA), "the purpose of Diabetes Self-Management Education and Support (DSMES) is to equip people with diabetes with the knowledge, skills, and confidence to take responsibility for their own self-management, helping to prevent long-term complications".(61)

Thyroid Disorders: Patients can consult endocrinologists about thyroid function tests and medication adjustments, bypassing in-person visits. In addition, Teleassistance between specialists for thyroid nodules and cancer evaluation or cytopathology and operative pathology, allows experts to bridge geographic gaps. In some cases, remote monitoring has been implemented for hospitalized or isolated patients following high-dose radioiodine therapy, helping to minimize healthcare workers' exposure to these patients.(62)

e. Neurology:

Stroke Care: Telemedicine enables rapid stroke assessment and guides emergency treatment decisions. Neurologists can reliably interpret unenhanced brain CT images of acute ischemic stroke and determine treatment eligibility, whether it be through tissue plasminogen activator (tPA), endovascular clot retrieval (EVT), or anti-hypertensives.

A program developed in Germany known as TRANSIT-stroke, established a telemedicine network in rural hospitals, improving outcomes by enabling faster neurological assessments, timely treatments, and 24-hour access to neurologists.

Teleneurology: Patients with neurological debilitating conditions, such as epilepsy or multiple sclerosis, Parkinson disease, particularly those facing acute or chronic disabilities, often face significant physical challenges and costs when traveling for in-person consultations. Virtual appointments have become an ideal solution for providing them with adequate and convenient care.

Interpretation of epilepsy monitoring, EEG tracings, and intraoperative monitoring (IOM), combined with the emerging use of teleradiology for transmitting imaging (such as head CT and CT angiography) to handheld devices like smartphones and tablets, significantly enhances the ability to track patient conditions and facilitates rapid interpretation. This development improves access to critical patient imaging outside the hospital, enabling timely decision-making and more efficient remote care.(63)

Telemedicine has demonstrated significant benefits for patients with dementia and Alzheimer's, helping to extend treatment duration while improving adherence, quality of life, and both physical and mental health. It also enhances patients' sense of self-efficacy. Furthermore, remote speech therapy has proven effective for conditions such as primary progressive aphasia and alexia, with both patients and caregivers expressing high levels of satisfaction.(64)

f. Obstetrics and Gynecology:

Prenatal Care: Expectant mothers can have virtual check-ups for routine prenatal visits, and address any concerns with their obstetricians. Additionally, they can receive education on pregnancy health, like text message reminders about key aspects of pregnancy care, such as vaccination, maintaining a healthy diet, staying physically active, managing gestational weight gain, plus monitoring gestational diabetes with glucometer-cell phone units, and blood pressure monitoring for the early detection of preeclampsia.(65)

Menstrual and Reproductive Health: Telemedicine allows women to consult gynecologists about menstrual disorders, contraception, and menopause management.(66)

g. Pediatrics:

Telemedicine for neonatal care: has expanded significantly, moving from established uses like retinopathy of prematurity screening and tele-echocardiography to applications in genetics and neurology. In the Neonatal Intensive Care Unit (NICU), neonatologist-led remote rounding has proven effective in enhancing access to specialized care for neonates in rural hospitals. Additionally, telemedicine-assisted neonatal resuscitation has improved the quality of resuscitation and reduced unnecessary transfers to higher levels of care.(67)

Well-Child Visits: Pediatricians can conduct virtual visits to monitor growth and development, provide vaccinations, and address parental concerns. They can also diagnose and treat acute conditions, such as upper and lower respiratory tract infections. Additionally, follow-up care for children with asthma, using home spirometry and peak flow meters, can help assess lung function between in-office measurements.

Behavioral Health: Telemedicine can be used to assess and manage pediatric behavioral health issues, such as ADHD, Autism and anxiety disorders.

School-based Telemedicine Services: These services allow children to receive care at their local school , while in the presence of a school nurse or other school personnel.(68)

h. Gastroenterology:

Virtual Consultations: Patients with irritable bowel syndrome (IBS) can discuss gastrointestinal symptoms and receive dietary advice. Similarly, Patients with inflammatory bowel disease (IBD) can be monitored for flare-ups and medication adherence and side effects to achieve tight disease control. For patients with Celiac disease," **MyHealthyGut ®**" is the first evidence-based app with notable features like: therapeutic meal plans and recipes, a live Q&A bot, educational content, a virtual health coach, and a report creation platform, allowing users to share their progress with physicians in real-time.

Telemedicine has also been integrated into the care of high-risk populations, such as people who use drugs and prisoners, to improve HCV (Hepatitis C Virus) care. In the context of post hepatic transplantation care, telemedicine provides an alternative to traditional clinic visits, offering a more accessible and efficient solution for this vulnerable patient population.

Tele-education: Through Project ECHO (Extension for Community Healthcare Outcomes), the virtual transfer of endoscopic procedures to various academic centers allows for continuous education and skill development among healthcare professionals, ensuring broader access to specialized knowledge.(69)

i. **Oncology:**

Follow-up Care: Cancer patients can have virtual consultations to monitor treatment progress, manage side effects, and receive supportive care. These sessions also provide an avenue for mental health support, helping patients cope with the emotional challenges of their diagnosis and treatment journey.

Second Opinions: Telemedicine allows patients to obtain second opinions from oncologists regarding treatment plans without the need for travel.

Pain Management: Telemedicine offers chronic pain assessments and the development of management strategies, including restocking of medications like opioids.

Multidisciplinary Tumor Boards: Telehealth facilitates virtual tumor board meetings, enabling continuous multidisciplinary collaboration to determine the most effective treatment plan for cancer patients.(70)

j. Orthopedics:

Post-Operative Follow-Up: Patients recovering from orthopedic surgeries can utilize virtual check-ins to assess healing, discuss rehabilitation exercises, and manage pain.

Consultations for Injuries: Patients with musculoskeletal injuries can consult orthopedic specialists for diagnosis and treatment recommendations.

Physical Medicine and Rehabilitation: Virtual rehabilitation programs that support patient recovery through guided physical therapy at home.(71)

k. Dermatology:

Teledermatology enables dermatologists to remotely assess and diagnose skin conditions by reviewing images sent by patients, leading to faster diagnoses and treatment plans. It also facilitates follow-up care, allowing for the monitoring of ongoing treatments and skin lesions. With mobile teledermoscopy, patients can collect images using a smartphone with a dermoscopic attachment for short-term monitoring. Studies show that mobile teledermoscopy achieves 81% to 91% diagnostic concordance with in-person assessments.

One of the key benefits of teledermoscopy is its role in triage, and mass screening reducing unnecessary referrals, wait times, and costs associated with in-person dermatological care.(72)

l. Teletherapy:

Refers to the delivery of mental health services remotely, including individual therapy sessions via video calls or chats, making psychological support more accessible. It has proven effective in treating a range of conditions, such as anxiety, post-partum depression, autism spectrum disorders, eating disorders, post-traumatic stress disorder (PTSD), and substance abuse issues. Teletherapy also includes cognitive behavioral therapy (CBT) and group therapy, providing patients with skills training, symptom management, and behavioral activation.(73)

m. Teleophthalmology:

Teleophthalmology is an effective tool for the remote screening and monitoring of eye conditions, such as diabetic retinopathy, glaucoma, and post-operative cataract care. Digital imaging systems like "**Digi Sight®**" enable early detection and prompt intervention, ensuring that patients receive timely and effective treatment. Additionally, teleophthalmology contributes significantly to prevention efforts, research advancements, and the ongoing education of healthcare professionals.(74)

n. Palliative and Hospice Care:

Telemedicine can facilitate ongoing communication and support for patients receiving palliative or hospice care, enabling healthcare providers to assess symptoms, offer emotional support, and coordinate care among multidisciplinary staff, including family members, reducing their burden and enhancing the quality of end-of-life care.(75)

o. Hematology:

Management of both malignant and non-malignant hematological conditions, through telemedicine services, to monitor vital signs, side effects, and lab results. This is especially important for patients undergoing treatment, such as anticoagulation therapy, particularly those living far from specialized care centers.(76)

p. Geriatrics:

Telehealth services are increasingly utilized for elderly patients, offering tailored care for chronic disease management, wellness checks, and mental health treatment. These services support primary care, medication management, healthcare coordination, and emergency care, ultimately enhancing the quality of care for seniors while lowering healthcare expenses.

Telehealth reduces potentially harmful exposures by utilizing fall detection and prevention devices that alert caregivers in real-time. This technology strengthens connections among providers, patients, and families, while also alleviating stress for caregivers.(77)

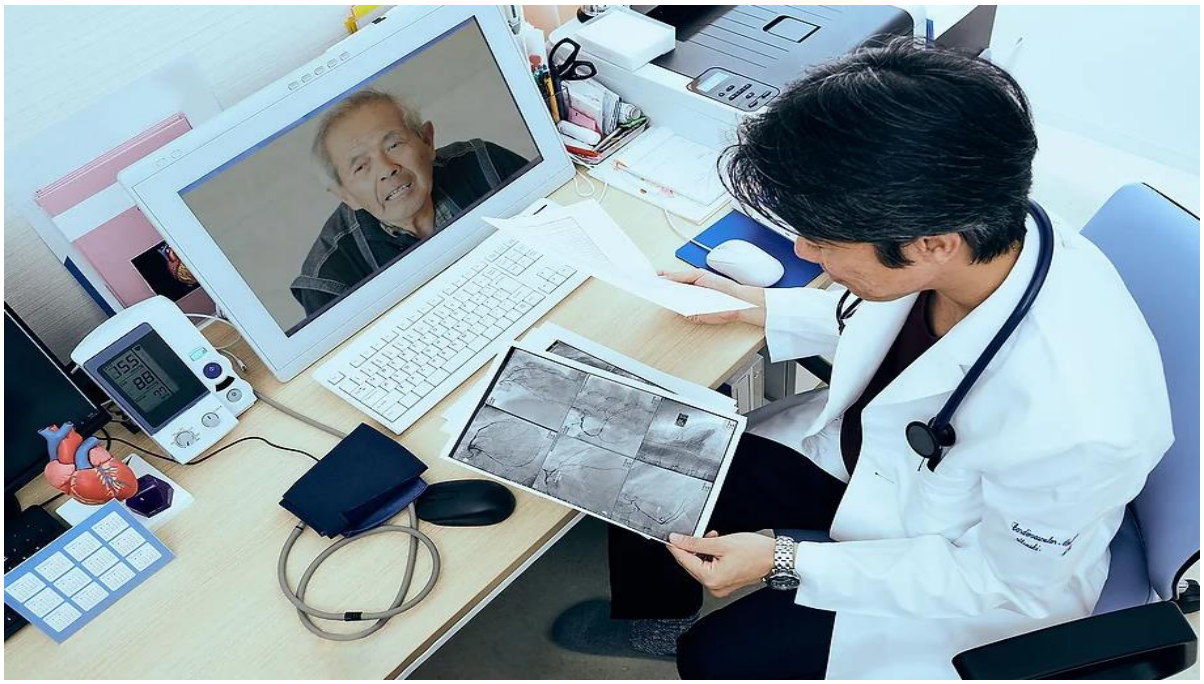

Figure 31: Telemedicine in Geriatrics: Optimizing Care for Elderly Patients.(78)

q. Telepharmacy:

Refers to the provision of pharmaceutical care by registered pharmacists using telecommunications to patients at a distance. Services include medication selection and reconciliation, order review, dispensing, patient counseling, monitoring, medical management, staff training, and patient education. Particularly beneficial for patients with chronic conditions requiring ongoing treatment. In Spain, telepharmacy has been implemented for home delivery of HIV medications, while in France, it has been used to supervise the preparation of anti-neoplastic medications.(79)

r. Telesurgery:

Telesurgery, a rapidly evolving field, harnesses advanced robotic systems and communication technologies to enable surgeons to perform procedures remotely. This innovation allows highly skilled medical professionals to extend their expertise, by using high-definition imaging, robotic arms, and real-time transmission of surgical commands. On November 16, 2024, Morocco achieved a historic milestone in telesurgery by setting a new record for the longest remote surgery ever performed, an intercontinental robotic prostatectomy conducted over a distance of more than 12,000 kilometers. This groundbreaking procedure was orchestrated between Casablanca and Shanghai. Dr. Youness Ahallal, a urology surgeon and oncology expert at Oncorad Group, led the operation from Shanghai, while a dedicated team of Moroccan urological specialists and anesthesiologists executed the surgery on-site in Casablanca. Utilizing the advanced Toumai surgical robot and a sophisticated communication platform, the team successfully completed the operation in under two hours, benefiting from high-definition 3D imaging and precise coordination.(80)

Figure 32: A Leap in Telesurgery: Dr. Ahallal's Record-Breaking Prostatectomy.(80)

s. Urology, Nephrology, Rheumatology, Telepathology, Infectious Diseases, ENT, Genetics, Nutrition and Dietetics, Occupational Medicine…etc.

II. Ethical and Legal Framework in Telemedicine:

1. Ethical considerations:

Four major principles of medical ethics should be respected in developing and sustaining any health care program:

1) **Autonomy**: patients' right to make decisions about their medical care.
2) **Beneficence**: a provider's duty to benefit the patient in all situations.
3) **Nonmaleficence**: a provider's duty to harm neither the patient nor society during the care of that patient.
4) **Justice**: a provider's duty to ensure fairness in medical decisions, implying equal distribution of scarce resources and new treatments, and upholding applicable laws and legislation.(81)

↳ Ethical principles tailored specifically to telemedicine:

Privacy and Confidentiality:

- Physicians who respond to individual health inquiries or offer personalized health advice online, must ensure that the websites they associate with have adequate measures to safeguard the confidentiality of personal information shared through the platform. Additionally, they should notify website users about the potential privacy risks associated with electronically transmitting personal health information, for example, through a written disclaimer on the site.

Transparency and informed consent:

- In the context of telehealth, Patients must be informed not only about medical issues and treatment options, but also about the distinctive modalities of telemedicine, the associated risks and benefits, and their rights.
- Consent should be obtained before any consultation, either through a written or electronic format: Healthcare professionals should ensure that the patient understands how the remote consultation will proceed and agrees to it.

Fidelity:

- The practice of medicine, in any care model, is fundamentally a moral activity rooted in a "covenant of trust" between the patient and the physician.
- Patients need assurance that physicians prioritize their well-being above all else. To uphold this trust, telehealth professionals should actively minimize conflicts of interest and disclose any financial or commercial ties that could influence their responsibilities.

Competence:

- The obligation of competence mandates, that physicians addressing specific health inquiries possess the necessary clinical qualifications and experience, along with access to essential information for informed recommendations.
- It further entails proficiency in the use of the relevant technologies and comfort in employing them to interact with patients.
- Competency also involves physicians recognizing the limitations of telemedicine technologies and knowing when to transition from telehealth to in-person care.

Continuity of Care:

- Meeting the duty to not abandon the patient and to ensure continuity of care is essential.
- The information provided should encompass recommendations for follow-up care, when it is deemed necessary.
- Maximizing the benefits of telemedicine while minimizing its drawbacks requires more than the efforts of individual physicians. It demands a collective approach, with contributions from the entire medical community, active participation from professional organizations in healthcare and technology, as well as proper education and support for clinicians to adapt to this evolving field.

Equity in Access to Care:

- The use telemedicine must be equitable and uphold the highest ethical standards, respecting the dignity of all individuals and avoiding marginalization due to factors like education, language, location, age, gender, or abilities. (82)

2. Legislation and Jurisdiction:

The 3 Legal texts regulating Telemedicine practice in Morocco:

1. **Law 131-13,introduced on March 19, 2015** , concerning the practice of medicine in Morocco.(83)
2. **Decree 2-18-378, established on July 23, 2018,** sets the regulatory framework for telemedicine acts.(84)
3. **Law 09-08, developed on February 18, 2009,**regulates personal data safety.(85)

Table IV: Overview of Law texts regulating Telemedicine in Morocco:

Scope of Telemedicine	Law 131-13, Article 99: "Telemedicine consists of using new information and communication technologies (ICT) remotely in medical practice. It connects healthcare professionals, with each other or with the patient, involving other care team members as needed, all under the primary doctor's supervision."
Permitted Telemedicine Services	Allows five primary services: Teleconsultation, Tele-expertise, Telemonitoring, Teleassistance, and Medical Emergency Management.
Security Standards	Law No. 2-18-378, Chapter III: "It is the responsibility of healthcare professionals to ensure that the information and communication technologies used comply with the applicable legal and regulatory provisions, particularly those concerning the protection of personal data processing and those related to the electronic exchange of legal data. The conditions to be met for a digital signature, especially in a medical e-prescription, are specified in this article.

Legal Liability	Establishes legal liability for healthcare providers, ensuring that any medical errors or malpractice in telemedicine are subject to the same standards as traditional medical care. Physicians are responsible for ensuring the accuracy and quality of content, but are not expected to be accountable for how individuals act on the information they find on telehealth websites.
Licensing and Authorization	Under an implementing decree of Law 131-13, telemedicine in Morocco requires specific authorization from the Minister of Health, granted following approval by the National Council of the Order of Physicians. This authorization is limited to licensed Moroccan doctors or health professionals registered with Moroccan authorities and varies in process between the public and private sectors. Telemedicine is practiced under the responsibility of the director in public establishments, the medical director in private establishments (clinics or similar institutions), and the physician when it is practiced in a private practice.
Patient Rights and Ethical Standards	Article 2 of Law 131-13 mandates that all medical practices, including telemedicine, respect legality and uphold patient rights. It strictly prohibits the commercialization of medical practice and discrimination of any kind. Patients are granted the right to freely choose their physician and must be treated with respect for their dignity, integrity, and privacy. The article also requires that patients receive clear information regarding their diagnosis and treatment plan, promoting informed decision-making and transparency in their medical care journey.

Insurance and Remuneration	Telemedicine offers new possibilities in healthcare through its various acts, and a precise typology describes these different use cases. Currently, In Casablanca, Morocco is piloting community health services featuring telemedicine-enabled "mediot cabins," with practitioners remunerated and patients covered by CNSS insurance. These projects are part of the country's broader digital health reforms. If successful, this initiative could lead to nationwide implementation, supporting Morocco's goal of universal health coverage and reducing disparities in care delivery. However, In France, the reimbursement for telemedicine services aligns with that of traditional in-person consultations, typically set at 70%. However, this rate can increase to 100% for individuals in underserved areas, in maternity care, the elderly, and patients with chronic conditions.(86)
Medical Record Keeping	Law 09-08, article 23, “The responsible party must implement measures to protect personal data against accidental or unlawful destruction, loss, alteration, or unauthorized access, particularly during network transmission. Telemedicine consultations require secure documentation and management of electronic health records in line with data storage regulations to ensure patient information remains safeguarded”.

III. Asthma Management Data:

1. Asthma in Focus: Definition, Epidemiology, and Global Impact:

a. Defining asthma:

The 2024 Global Initiative for Asthma (GINA) report characterizes asthma as follows:

Definition: Asthma is described as a heterogeneous disease involving chronic inflammation in the airways. It features respiratory symptoms (wheeze, cough, chest tightness, shortness of breath, and dyspnea on exertion) that fluctuate in frequency and in intensity over time, with expiratory airflow limitation that may become persistent.

Complexity: Due to its heterogeneous nature, asthma presents a range of clinical manifestations, treatment responses, and trajectories, highlighting the need for individualized management strategies throughout the patient's life.

Phenotypes: Certain clusters of demographic and clinical traits, termed "clinical asthma phenotypes," are recognizable. However, these phenotypes don't consistently align with specific pathological mechanisms or responses to treatment.

Diagnosis and biomarkers: Although clinical tests like spirometry are the preferred standard for diagnosing asthma, diagnostic approaches in real-world settings remain highly variable. Asthma is commonly associated with airway hyperresponsiveness and inflammation, but these features are not strictly required for diagnosis. In light of this variability, biomarkers reflecting the underlying pathophysiology of asthma have gained importance in clinical practice, particularly for evaluating difficult-to-treat asthma and tailoring treatment strategies in severe cases.(2)

b. Prevalence and Mortality Rates:

Asthma is a critical global health issue, affecting approximately 300 million individuals around the world and resulting in around 1,000 deaths daily, predominantly in low and middle-income countries. Most of these fatalities are preventable with proper management.(2)

Furthermore, asthma prevalence is on the rise, and the WHO (World Health Organisation) projects that this condition will result in approximately 27,000 deaths in the Eastern Mediterranean Region by 2030.(87)

The 2022 Global Asthma Report highlights the challenges in accurately estimating global asthma prevalence, primarily due to variations in survey methods and differences in diagnosis. The Global Asthma Network (GAN) Phase I study, conducted between 2015 and 2020, followed the standardized ISAAC (International Study of Asthma and Allergies in Children) protocol to assess asthma symptoms across schoolchildren (aged 6-7), adolescents (13-14), and adults. The study found that the overall prevalence of asthma symptoms was 9.1% in children, 11.0% in adolescents, and 6.6% in adults.(88)

Asthma affects up to 20% of the population in developed countries, while its prevalence is generally lower in developing regions. However, its incidence is rising in economically developing nations, creating widespread health challenges and significant economic strain.

In the Netherlands, a study found that approximately 3.7% of asthma patients have severe asthma. This was determined by identifying patients prescribed high-dose ICS-LABA or a combination of medium- to high-dose ICS-LABA with long-term OCS, who still exhibited poor symptom control (as measured by the Asthma Control Questionnaire) despite good adherence and proper inhaler technique. This finding underscores the challenges in effectively managing severe asthma.(2)

The American Lung Association reports that in 2021, asthma was responsible for 3,517 deaths in the United States, with women accounting for 59% of these fatalities. Asthma mortality rates revealed significant racial disparities, as the death rate among Black individuals was 2.1 times higher than that of White individuals. Despite a 44% decrease in the asthma related fatalities ,from 1.7 per 100,000 population in 1999 to 1.0 in 2021, progress has slowed since 2007, signaling the need for continued efforts to address disparities and improve asthma outcomes.(3)

In MOROCCO, The Asthma Insights and Reality in the Maghreb (AIRMAG) study, a cross-sectional epidemiological survey, was conducted on a random sample of the general population in Morocco. The study took place between January and May 2008, and revealed that, as of 2009, 3.89% of the Moroccan population was affected by asthma, equating to more than 1.2 million people (89). As revealed in later research, for instance according to ISAAC, the prevalence of asthma is around 10-20% of the population. Among children aged 13-14 years, asthma prevalence reaches approximately 20%, while in adults, it ranges from 15-17%.

Historical data shows a significant increase in asthma cases: in 1984, the prevalence ranged between 2.2% and 5.5%. A decade later, in 1995, the ISAAC study conducted in Rabat, Casablanca, and Marrakech, found asthma prevalence rates between 6.6% in Rabat, 12.1% in Casablanca, and 17.1% in Marrakech, doubling in 10 years.

More recent studies, such as one conducted in Benslimane in 2000, reported a prevalence of 8.9%, while a retrospective study in Tétouan between 2009-2012, found a rate of 6.3%. A study in Errachidia also found a lower prevalence at 4.8%.(90)

c. Global Impact:

High Prevalence, Morbidity and Mortality rates as mentioned in the section before.

Economic Burden of Asthma:

Asthma imposes substantial financial burdens globally, estimated to be in the hundreds of billions of dollars. With economic costs surpassing those of tuberculosis and HIV/AIDS combined.

In developed countries, asthma accounts for 1–2% of healthcare budgets, with annual per-patient costs ranging from $300 to $1,300.

In the United States, asthma-related costs exceed $80 billion annually, including direct medical costs like office visits, hospitalizations, medications, and emergency room visits, which average $1,500 per visit.(4)

Direct costs include medical expenses such as inpatient care, emergency visits, physician visits, nursing services, ambulance use, drugs and devices, blood and diagnostic tests, research, and education. Totalling to $3,000 per patient annually in the U.S.

Indirect costs include lost productivity, absenteeism, and waiting times. In Spain, asthma-related work absences result in an average cost of €285 (US$315) per patient monthly. Furthermore, family impacts are notable; in England, 69% of caregivers for asthmatic children reported missing work, and 13% lost jobs due to caregiving responsibilities.

Chronic management needs make asthma one of the leading contributors to healthcare expenditures worldwide, especially in low-resource settings. For example, in many developing countries, the cost of asthma maintenance therapies, such as inhaled corticosteroids, can be prohibitive for families, leading to under-treatment and more frequent hospitalizations.(91)

Healthcare Utilization:

Asthma is a major driver of healthcare utilization, including outpatient appointments, emergency department trips, and hospitalizations. In the United States, asthma exacerbations lead to approximately 1.8 to 2 million emergency department visits each year. Similarly, a study in Spain found that patients with severe persistent asthma, accounted for significantly higher healthcare utilization, requiring frequent hospitalizations, multiple emergency visits per year, and prolonged intensive care units stays. This heightened demand for urgent care adds substantial costs and strains healthcare systems.(4)

Impact of Environmental Factors:

Environmental factors, including air pollution, allergens, and climate change, significantly influence the prevalence and severity of asthma, contributing to increased symptoms and exacerbations (4).The higher asthma rates observed in developed countries may be attributed to urbanization, Westernized lifestyles, rising obesity rates, and high exposure to pollution. (92)

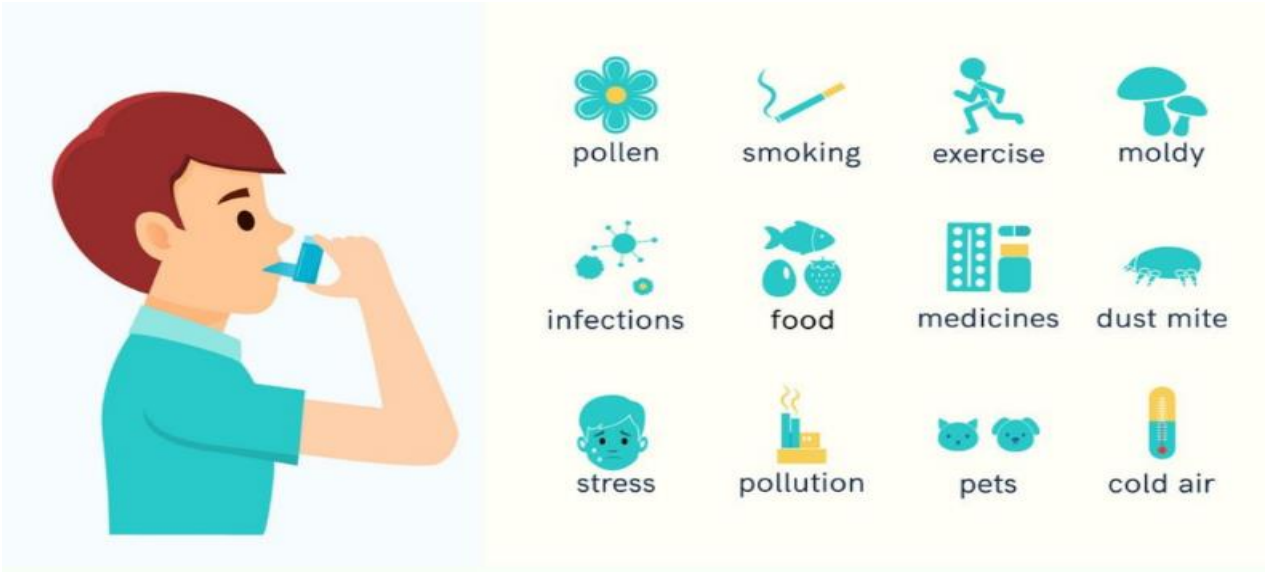

Figure 33 : Asthma triggers. (93)

Social and Psychological Impact :

Mental strain: The burden of asthma goes beyond physical health, affecting patients' quality of life and psychological well-being. Many individuals with asthma experience mental health challenges such as anxiety, depression, and social isolation as a result of their condition.

Anxiety in Adolescents: Adolescents with asthma are twice as likely to experience clinically significant anxiety symptoms compared to their healthy peers. An estimated 20-40% of these adolescents meet the DSM-IV criteria for anxiety disorders. (94)

Impact on Children's Physical and Social Life: Children with asthma may face limitations in physical activities, which often leads to reduced involvement in sports and social events. This can hinder their overall development and negatively affect their quality of life.

Academic Performance: Asthma can also impact academic performance, as children may struggle to keep up with schoolwork due to physical limitations or psychological factors.

WHO Perspective on Asthma and Psychological Effects: According to the World Health Organization (WHO), asthma is often linked to unconscious conflicts and repressed desires in children, which can manifest as pure anxiety, depression, poor school performance, and emotional or behavioral issues, such as attention disorders, ADHD, sleep problems, and both internalizing and externalizing behaviors.

Externalizing vs. Internalizing Behaviors: Externalizing behaviors are outwardly directed, such as inattention, aggressiveness, and defiance. Internalizing behaviors, such as social withdrawal, anxiety, and depression, are inward-focused and may lead to self-harm or emotional disturbances.(95)

2. Practical implications of telemedicine in asthma care:

Improved Access to Care: Remote consultations increase healthcare access for asthma patients in rural, underserved areas, as well as for the elderly, disabled, and those in culturally isolated or incarcerated groups.(96)

Real-Time Monitoring and Data Collection: clinicians can track asthma symptoms and medication adherence in real-time, allowing for timely interventions and early detection of disease progression (97).Allowing for adjustments of medications and lifestyle, promoting ongoing preventive care.(98)

Tele-Consultation for Chronic Comorbidities: Many asthma patients suffer from chronic comorbidities (allergies, obesity, rhinitis, nasal polyposis, GERD, and stress). Telemedicine allows for holistic management of these conditions simultaneously in virtual consultations.(97)

Flexible and Continuous Follow-Up Care: Telemedicine ensures ongoing support through flexible, asynchronous follow-ups via text or email, maintaining care continuity between visits and contributing to a reduction in no-show rates. (97)

Emergency Response and Acute Management: provide rapid access to medical advice and guidance, even outside of regular office hours.

Personalized Care Plans: Telemedicine enables tailored asthma management by addressing each patient's unique triggers, symptoms, and medication requirements. This individualized approach ensures more effective and patient-centered care.(97)

Remote Pulmonary Rehabilitation: offering exercise programs, breathing techniques, and educational sessions. This can be especially helpful for patients with more severe asthma or those recovering from an exacerbation.(99)

Cost-Effectiveness: Telemedicine reduces asthma management costs by minimizing physical appointments, transportation, and hospitalizations. Studies show that patients using telemedicine spend less time in the hospital and save on travel expenses like fuel.(96)

Reduction in Healthcare Burden: by minimizing the need for in-person visits for routine check-ups. This offers its own set of advantages that increase the hospital's overall operability.(96)

Improved Workflow for Healthcare Providers: enabling them to manage more patients efficiently and spend more time focusing on complex cases that require immediate attention.

Reduced Wait Times: Virtual consultations are particularly beneficial for patients with acute or chronic conditions like asthma, where timely interventions are crucial in preventing flare-ups.

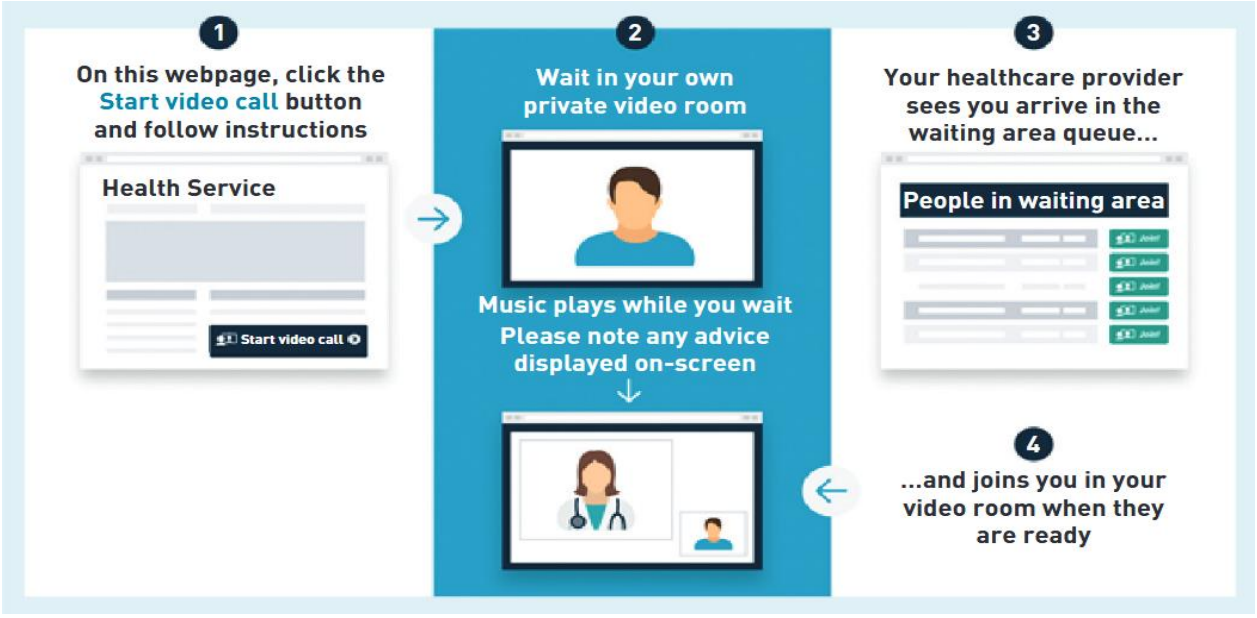

Figure 34: Teleconsultation Workflow: Emphasizing Efficiency, Convenience, and Reduced Wait Times.(100)

Training and Support for Healthcare Providers: offers opportunities for continuous training on new asthma management techniques, access to expert consultations, and collaboration with multidisciplinary teams worldwide, including community pharmacists.(101)

Supporting Asthma Research and Innovation: Data collected through telemedicine platforms provides valuable real-world insights into asthma management, treatment efficacy, and patient behavior. This enables data-driven decision-making, helping to identify trends, refine treatment protocols, and inform public health initiatives.

Multidisciplinary Care Collaboration: where different specialists (e.g., pulmonologists, allergists, dietitians, etc.) can work together remotely to provide holistic asthma care. This approach can help in managing complex cases more effectively.

Patient Education: Telemedicine offers easy access to educational content, such as instructional videos, quizzes, and informational brochures about asthma management (97). Family education is also emphasized, particularly in pediatric asthma care, where it plays a crucial role. (102)

Support for Asthma Education in Schools: Through telemedicine, schools can be connected with asthma specialists, providing resources for teachers and school nurses to manage asthma-related emergencies and educate students on how to handle their asthma triggers during the school day.(101)

Global Reach and Expertise: Telemedicine allows patients to access global expertise. This helps break down barriers to advanced asthma treatments and research.

Cultural and Linguistic Accessibility: Telemedicine improves communication by connecting patients with culturally competent providers who understand their unique needs. It also supports multilingual patients through real-time translation services, ensuring effective care across language barriers.

Improved Medication adherence: Poor adherence can be blamed for 24% of asthma exacerbations and 60% of hospitalizations related to asthma (42). Therefore, medication use monitoring, with the help of reminder systems through apps or texts can and alerts offers a practical solution to improve both short-term and long-term patient outcomes(102). Studies like Johnson et al. found a notable increase in inhaled-medication adherence rates with SMS-based reminders. Bender et al. reported a 25% higher inhaled-corticosteroid adherence rate among pediatric asthma patients using speech-recognition technology for automated telephone calls, which were linked to patients' electronic health records (EHR).(42)

Greater autonomy for patients: by providing access to educational resources, tools, and personal health data. Patients can actively participate in managing their asthma by scheduling appointments, communicating with healthcare providers on their terms, and utilizing resources to make informed decisions about their care.

Adoption of New Technologies: new wearable devices that monitor asthma symptoms, lung function, and physical activity, provide valuable data to clinicians. This data enables better-informed clinical decisions and personalized care. Other devices such as, smart inhalers and peak flow meters are increasingly used to monitor asthma medication adherence. Inhalers with integrated sensors have proven useful in tracking patient usage. A review by Nguyen et al. analyzed over 400 asthma-related apps and identified six that incorporated sensors into inhalers, they use either **Propeller Health ®** or **Breathe Smart ®** systems by Cohero Health to monitor medication use. The most commonly used apps for asthma management include **Kiss My Asthma ®, Asthma MD ®, AsthmaXcel ®, Asthma Australia ®, Ask Me (AsthMe!) ®, and MASK-air ®**.(101)

Digital inhaler systems (DIS) track the duration of inhalation post-actuation and the post-inhalation breath-hold time, key factors that indicate whether the medication is inhaled fully and retained in the lungs sufficiently long enough for optimal absorption. DIS incorporates audible coaching elements for proper inhaler technique, such as correct positioning and shaking, which improves treatment efficiency. The system is equipped with alerts, it features reminders for scheduled doses, medication supply tracking, and refill alerts therefore preventing interruptions in treatment. The data generated by DIS is accessible to both patients and healthcare providers, enabling clinicians to analyze the information via a dashboard to adjust treatment plans and make informed decisions(42).An example is the **Digihaler ®** by TEVA Pharmaceuticals, which includes sensors in SABA, ICS, and ICS/LABA inhalers (e.g., **AirDuo®** and **ArmonAir®** Digihalers) to track adherence.(101)

Data Analytics and Artificial Intelligence: helps healthcare providers detect patterns in patient behavior, medication use, or asthma triggers. A study done by Topalovic showed that AI was superior compared to pulmonologists in interpreting spirometry and correlating them with a correct diagnosis of asthma.(101)

Teleallergy: a promising advancement that includes remote allergy testing and monitoring where patients use at-home testing kits, and share the results with their treating physicians to adjust treatment plans accordingly. (103)

Environmental Sensitivity Monitoring: allows patients to receive real-time feedback about environmental triggers, such as pollution or allergens, and adjust their activities accordingly, with the use of environmental sensitivity monitoring tools (e.g., sensors for air quality or pollen levels).(101)

Virtual Support Sessions: by providing psychosocial care through individual or group virtual counseling, patients can benefit from emotional support while fostering a sense of community and mutual understanding. This approach is particularly effective in reducing anxiety, especially for children or patients with severe asthma who might feel overwhelmed by hospital visits.

Quality of Life Monitoring: by asking patients to report on factors such as sleep disturbances, exercise limitations, or work absenteeism. And fill out quality of life surveys like the WHO-5 Well-Being Index and Asthma Control Tests (ACT) (102). More recently, Portnoy et al. found that telemedicine was as effective as in-person visits in terms of ACT scores and family satisfaction, while van den Wijngaart et al. demonstrated more symptom-free days and improved ACT scores with virtual asthma clinics compared to in-person care.(42)

Crisis Management: During public health crises (pandemics), telemedicine provides a safe alternative for patients to receive care without the risk of exposure to infectious diseases.

Sustainability in Healthcare: by reducing the carbon footprint associated with patient travel to appointments.(42)

IV. Exploring Cost Trends in Asthma Care:

1. Public and Private Systems:

A comprehensive analysis of administrative data from hospitals in New York investigated the relationship between hospital characteristics and asthma-related costs for pediatric patients. Hospitals were categorized as teaching versus non-teaching, and private versus public. The findings revealed that the mean cost of asthma care was slightly higher in private hospitals compared to public hospitals ($1,868 vs. $1,771), and in non-teaching hospitals compared to teaching hospitals ($1,876 vs. $1,528). However, after adjusting for factors such as patient demographics and hospital attributes, these differences in mean costs between private and public hospitals were no longer statistically significant.

Descriptive Analysis: While private and non-teaching hospitals initially appeared costlier, the adjustments highlight that factors beyond hospital type, likely including patient complexity and institutional resources play a crucial role in cost determination.

In contrast, a study from a teaching hospital in an urban Canadian setting during the 1990-1991 fiscal year reported operating expenses per inpatient day to be ($681.70) for teaching hospitals versus $496.81 for non-teaching hospitals. Similarly, another cohort study found no significant differences in hospital charges between teaching and non-teaching hospitals after accounting for patient and hospital characteristics, such as age, severity of illness, comorbidities, and hospital size.

Descriptive Analysis: These findings suggest that teaching hospitals might have higher baseline operating costs due to additional resources such as research and training facilities, but patient care costs per discharge can become comparable when adjusted for other variables.

A five-year population-based study adopted hospitalization data from the Taiwan National Health Insurance Research Database which included a total of 139,630 cases, it yielded different results regarding costs per hospital discharge. This study indicated that public hospitals had the highest costs per discharge ($656.84) compared to not-for-profit ($514.08) and for-profit hospitals ($411.95). The inclusion of asthma patients discharged with outpatient referrals, who typically incur higher costs, might have contributed to the elevated figures for public hospitals. **Descriptive Analysis**: Public hospitals may face greater financial burdens due to a higher proportion of patients with complex needs or incomplete recoveries requiring follow-up care, compared to private or for-profit institutions that might cater to less severe cases.(104)

In summary, asthma management costs tend to be higher in private and teaching hospitals, driven by advanced technologies, specialized care, and research activities. Variability in costs is influenced by patient severity, resource availability, and institutional priorities, highlighting disparities in healthcare settings.

2. Telemedicine and Traditional Consultations:

A retrospective study conducted by Waibel et al. between January 2014 and December 2015 reviewed 112 telemedicine visits for asthma and allergy management. The findings revealed significant cost savings and reduced in-person visit requirements, including 200 saved work or school days, a reduction of $58,000 in travel expenses, and spared patients from covering 80,000 kilometers of unnecessary travel.(103)

Delgoshaei et al. demonstrated that telemedicine for delivering outpatient pulmonary care to rural populations can be more cost-effective, with an annual expenditure of $335 per patient, compared to the traditional care models; approximately $585 per patient annually for general outpatient care, and $1,166 per patient per year for specialist facility-based care. Additionally, Ryan et al. conducted a multicenter randomized controlled trial involving 288 adolescents and adults with poorly controlled asthma. Their study assessed both the clinical and cost-effectiveness of mobile phone-supported self-monitoring for asthma, revealing significant insights into the benefits of remote asthma management.(105)

Urgent care is a vital component of asthma management, especially for handling acute exacerbations. A study conducted in North Carolina, in 2018 compared Virtual Urgent Care (VUC) to in-person urgent care (UC) visits, analyzing 16,685 total visits (14,734 in-person, 1,262 virtual). The results showed significant differences: VUC visits took an average of 9.38 minutes, while in-person visits took 70.89 minutes. VUC also saved patients time and costs associated with travel, which averaged 34-37 minutes, wait times for in-person UC ranged from 22.5 to 55.27 minutes (2.5 to 17 hours in emergency departments), while the VUC model was able to cut out the waiting time altogether. The total cost of VUC was $49, just one-third of the $142.66 for in-person visits, reflecting savings in both service fees and travel expenses. These findings suggest that virtual care can reduce healthcare costs and improve access, benefiting asthma management by minimizing patient burden.(106)

Descriptive analysis: Telemedicine has proven to be a cost-effective and efficient solution for asthma management, reducing travel, wait time, and financial burdens. while enhancing affordability and convenience, offering significant benefits for both routine and urgent asthma care.

V. Obstacles to Widespread Telemedicine Adoption:

Safety concerns: in emergency situations, such as acute asthma exacerbations, telemedicine may be insufficient in providing the immediate, life-saving interventions necessary. The inability to administer critical care or perform urgent laboratory tests remotely can result in delays in essential treatment, potentially compromising patient safety.

Limited Physical Examination: Certain medical conditions require a physical examination for accurate diagnosis and treatment. Telemedicine may not be suitable for all patients, particularly those with complex health issues that necessitate in-person assessments.(107)

Efficacy Uncertainty: There is ongoing debate about the effectiveness of telemedicine in various medical fields, necessitating further research to validate its utility (96) .Additionally, concerns about data accuracy is frequently mentioned, whether the concern was due to lack of trust of the technology, invalid patient measures, or concerns of false positives.(108)

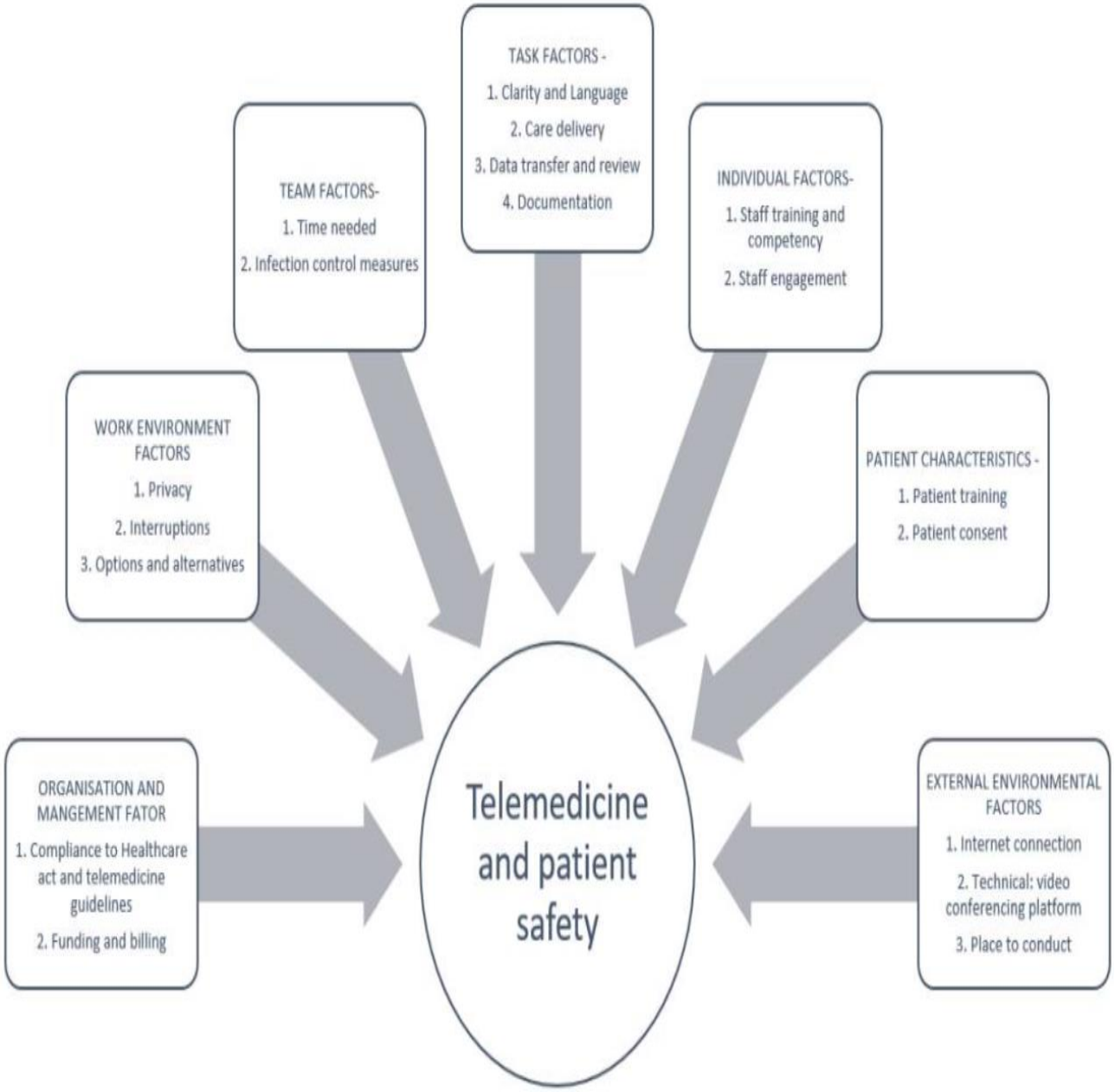

Figure 35: Key Elements of Patient Safety in Telemedicine: Challenges in Ensuring Compliance.(109)

Equity to access barriers: Telemedicine access disparities are particularly prevalent among vulnerable populations, such as low-income individuals, the elderly, and those with limited education. These groups may lack access to necessary technology or the skills to effectively use it, putting them at a disadvantage when it comes to receiving remote care.

Privacy challenges: There is a serious issue of hacking patient's medical data, especially if the patient connects to telemedicine platforms from a public network or unencrypted channels. (96)

Patient Compliance and Follow-Up: This is impacted by some patients' preferences for in-person visits, discomfort with wearable monitors, and time zone differences, which can affect follow-up care.(110)

Patient and Provider resistance to change: A significant barrier is the profound transformation that telemedicine (TM) brings to traditional medical practices and patient care delivery. The shift towards remote consultations with the aid of digital technologies challenges long-standing medical organizational structures and the methods of conducting medical procedures. Physicians, who have been trained over generations in the esteemed tradition of hands-on, clinician-patient interactions, often struggle to envision the practice of medicine at a distance through technological means.(25)

Lack of training: deficiency in training constitutes a critical obstacle to the widespread adoption of telemedicine. According to a study in Saudi Arabia, the most frequently identified barrier among healthcare providers in hospitals that have not implemented telemedicine was by (71%) the lack of awareness about its definition, types, applications, and benefits. This was followed by insufficient time to integrate telemedicine into practice (39.7%) and a perception that telemedicine is of limited importance in clinical care.(111)

Human Resource Limitations: A challenge on the human resources front is the shortage of personnel specifically allocated to conduct regular telemedicine consultations. This gap presents a significant barrier to the effective implementation of telehealth services, as there may not be enough qualified staff available to manage and deliver remote care.

Cost challenges: Telemedicine can prove prohibitively costly for smaller healthcare facilities primarily due to the high initial investment required for its implementation (96). These financial hurdles include the costs of upgrading infrastructure, acquiring necessary equipment, and the misalignment between existing billing codes and reimbursement policies, which often undervalue teleconsultations. Additionally, recruitment and retention of qualified teleconsultants, especially in rural areas with high turnover rates, present significant barriers. As a result, many projects are abandoned due to insufficient technical resources, such as the lack of affordable, functional solutions and a shortage of skilled personnel to support these initiatives.(112)

Technical and technological Setbacks: Technical literacy plays a critical role in the effectiveness of home monitoring systems for asthma management, as patients must be able to navigate and operate the digital tools involved (110). Alongside this, patient training is essential to ensure that they properly maintain the sensors and actuators that are integral to the system, preventing malfunctions. Despite these efforts, patients still carry the responsibility of ensuring their smartphones, which are often used to connect with monitoring apps, are in proper working order. This includes keeping the device charged, checking Wi-Fi functionality, and avoiding the installation of apps that might interfere with healthcare applications. The trustworthiness of patients is also a key factor, as these systems rely on accurate data input, which may be compromised by intentional or unintentional errors. Additionally, the customization of asthma interventions based on age-specific needs presents a challenge. Younger children, especially those aged 0–4 years, exhibit a higher prevalence of uncontrolled asthma, emphasizing the need for tailored approaches that consider age differences (47.3% versus 34.8% in adolescents aged 12–17 years).(113)

Regulatory and legal issues:

The Ryan Haight Act restricts the prescription and distribution of controlled substances online, requiring a valid prescription that is based on at least one previous in-person patient examination. This stipulation prevents healthcare providers from prescribing certain medications to patients who are unable to attend in-person consultations. Additionally, hospital accrediting bodies have repeatedly changed their credentialing requirements for physicians, creating further uncertainty for telemedicine practices.(112)

Jurisdiction and liability rules can complicate the telehealth landscape, exposing healthcare professionals to potential legal challenges. Furthermore, licensing regulations vary between countries. In Morocco, only the treating physician is authorized to provide telemedicine services, while in France, midwives and dental surgeons are also permitted to engage in telemedicine practices under the Public Health Code.

The French National Agency for Supporting the Performance of Health and Medico-Social Institutions (ANAP), highlighted the challenges of establishing effective, sustainable governance and management for complex, multi-stakeholder projects involving innovative organizations and technologies. This difficulty is particularly relevant in contexts lacking strong political advocacy to adopt and champion telemedicine initiatives, emphasizing the need for cohesive leadership to ensure project success.(25)

Insurance and Reimbursement Hurdles: the lack of reimbursement for telemedicine services, particularly for non-radiology services, is a major barrier to its adoption. Nearly 90% of both current users and potential users have expressed that they would be more likely to use telehealth if reimbursement was available (114).This financial challenge is compounded by the absence of standardized reimbursement policies, as many insurance providers still hesitate to cover telehealth services. To address this, 19 U.S. states have implemented "parity" legislation, which requires third-party payers to reimburse telemedicine services at the same rate as in-person consultations. (112)

Logistical and Organizational Barriers: the integration of telemedicine into existing healthcare systems presents significant challenges, particularly in ensuring system interoperability. As nations restructure their healthcare delivery models, it becomes increasingly important to align telemedicine technologies with established healthcare programs(115). Without clear organizational protocols, such as determining whether the Decision Support System (DSS) should alert the hospital to redirect requests to on-duty doctors, or if the primary caregiver should take on this responsibility ,delays can occur, potentially compromising patient outcomes (113). For instance, in South Africa, higher asthma mortality rates were observed on weekends, when access to healthcare was limited due to poor organizational structures (116). Moreover, the lack of a quality control panels for telemedicine services complicates the evaluation of these systems, hindering efforts to maintain consistent service quality and efficiency. The evaluation of these systems is often complex, expensive, and prolonged, hindered by methodological challenges and the need for specialized tools that are not always accessible. This gap in oversight undermines efforts to ensure consistent quality and efficient service delivery.

Infrastructure Barriers: The integration of telemedicine into healthcare systems is often hindered by a lack of adequate infrastructure (117). The gap between the capabilities of telemedicine and its actual impact is particularly evident in regions with underdeveloped healthcare infrastructure. Additionally, healthcare professionals, industrial stakeholders, and researchers are typically not accustomed to collaborating closely, making the seamless operation of telemedicine systems more challenging. Without the necessary technological foundation, telemedicine can struggle to meet its potential in providing effective care.(25)

Media underrepresentation: Despite the potential of telehealth solutions, the initiative has faced limited media attention, particularly from traditional outlets such as television, radio, and social media. Furthermore, information dissemination has largely relied on organic means, such as word-of-mouth, rather than through structured, strategic media campaigns. This lack of formal media engagement may hinder the broader acceptance and understanding of telemedicine among the general public and healthcare professionals alike.(23)

VI. Comprehensive and comparative Discussion of Our Study's Results:

1. Respondents' Profile:

Our study included 250 participants, predominantly 82% were general practitioners (with 12.4% certified GPs and 69.6% interns), while specialists made up 18% (7.2% pulmonologists and 10.8% residents). Most respondents (63.2%) were employed in the public sector, followed by (25.2%) at the University Hospital and (11.6%) in the private sector. Notably, among public-sector respondents, the majority (56%), were interns working in peripheral hospitals. This distribution highlights the prominence of public-sector engagement in the study, particularly among junior physicians in regional healthcare facilities.

A study by Rouidii et al. in 2020, Morocco, reported A total of 18 participants, comprising 3 medical professors (16.7%), 5 medical specialists (27.8%), 7 general practitioners (38.9%), and 3 residents (16.7%). In terms of workplace distribution, the participants were Moroccan doctors working in the public sector evenly split, with 9 physicians (50%) practicing in urban areas and 9 (50%) in rural areas.(118)

Table V: Comparison of Participant Profiles and Sector Representation:

Aspect	Our Study	Rouidii et al
Sample size	250 participants	18 participants
Participant roles	82% General Practitioners	38.9% General Practitioners
	7.2% Pulmonologists	27.8% Medical specialists
	10.8% Residents	16.7% Residents
Workplace distribution	Public Sector: 63.2%	Public Sector: 100%

2. Asthma Patient Caseloads:

Our survey results showed that the vast majority of practitioners (99.2%) regularly treat asthma patients, both in routine consultations and emergencies. When it comes to weekly caseloads, most practitioners see between 5 and 10 asthma patients (39.9%), followed by those managing fewer than 5 patients accounting for (26.6%), and those handling more than 10 (33.5%). The two participants who reported not seeing asthma patients on a regular basis did not respond to the question regarding the frequency of asthma patient visits. This suggests a high level of engagement with asthma care across different caseloads.

A study by Kljakovic et al., conducted over five years (1986-1991) in Wellington, New Zealand, recorded a total of 3,844 asthma consultations, averaging 2.11 consultations per day. Notably, 21.5% of these consultations occurred on Mondays, indicating a distinct peak in asthma-related visits at the start of the week.(119)

3. Adoption of Telemedicine:

The majority of practitioners (61.6%) have reported prior experience with telemedicine, indicating a growing acceptance of technology in healthcare. However, fewer practitioners (38.4%) have not engaged with telemedicine services, highlighting potential barriers such as limited access or resistance to adopting new technology.

The study "Going mobile with primary care: smartphone-telemedicine for asthma management in young urban adults" by Mammen et al. in 2020, New York, revealed strong healthcare provider support for telemedicine in asthma care. Providers noted high satisfaction, citing improved workflow, communication, knowledge, and medication adherence.(120)

A study by El Gatit et al. in 2005, Libya, found that 12.2% of physicians had limited knowledge of telemedicine, while 39% demonstrated a high level of understanding, and 48.8% possessed a solid comprehension. It also noted that Libyan doctors' familiarity with technology played a pivotal role in shaping their attitudes toward the adoption of telemedicine.(121)

Similarly, Joseph et al. in 2006, Nigeria, observed that only 14.1% of physicians were aware of the benefits of telemedicine applications, underscoring a gap in knowledge that may hinder its widespread adoption.(122)

A mixed descriptive cross-sectional study conducted by Mounchayan et al. in 2019, in Midelt's provincial hospital, surveyed healthcare professionals on their knowledge and attitudes toward telemedicine. The results revealed that 63.6% of respondents were familiar with telemedicine, particularly teleconsultations (73.8%). Among the participants, 71.7% expressed an intention to incorporate telemedicine into their practice, and 66.6% were willing to participate in a telemedicine project.(24)

Rouidi et al. demonstrated that physicians in Morocco’s public sector are poised to adopt telemedicine, if there is a clear understanding of its substantial advantages for clinical practice. They perceive this technology as facilitating rapid access to current, critical patient information, addressing gaps within the public healthcare system, enhancing care accessibility particularly in rural areas and improving both the quality of care and physician productivity.(118)

4. Perception of Legal Responsibility:

Regarding professional liability, a significant majority (92.4%) of physicians believe that telemedicine implicates their civil and professional responsibility, recognizing their legal accountability for remote consultations. A smaller minority (7.6%) disagreed, which suggests some uncertainty or varying perceptions of the legal responsibilities involved in telemedicine practices.

In the review of the literature on telemedicine, the Polish Regulatory Framework and the Scope of Civil and Criminal Liability of Medical Staff in Telemedicine highlights that while diagnostic and therapeutic errors are common causes of harm, telemedicine introduces risks from organizational errors. These include inadequate preparation of facilities, insufficient information technology resources, and reliance on private equipment during remote work. Article 160(1–3) of the Civil Code emphasizes the liability of primary care physicians as guarantors of patient safety, particularly as they are bound by organizational standards established by executive regulations.(123)

The World Medical Association (WMA), asserts that telemedicine fully engages physicians' legal and civil liability. The treating physician remains accountable for decisions based on consultants' advice, and both parties must ensure the quality and safety of telemedicine services. Physicians should address telecommunication specific challenges and recommend in-person consultations when necessary.(124)

In conclusion, the findings indicate that most practitioners are engaged in asthma care and have adopted telemedicine to some extent. However, the significant number without telemedicine experience, combined with varying opinions on legal liability, highlights challenges in its full integration. Suggesting a need for further education and clarification of legal frameworks.

5. Management of Asthma Attacks:

The survey results reveal a cautious but growing openness among practitioners to using telemedicine for managing asthma attacks. While 41.2% of respondents supported the idea outright, a significant portion (46.4%) expressed hesitancy, responding with "maybe," and 12.4% opposed it. When specifying the types of asthma attacks suitable for telemedicine, most practitioners favored mild cases (93.2%), followed by moderate cases (56.8%). However, only 9.5% were willing to manage severe attacks remotely, reflecting concerns about the limitations of telemedicine in handling critical cases. These findings highlight both the potential and perceived risks of telemedicine in acute asthma care.

In a study by Halterman et al. in 2018, on asthma morbidity among urban children aged 3 to 10 years with persistent asthma in the Rochester City School District, New York, telemedicine (TM) proved beneficial. The intervention group experienced more symptom-free days (11.6 vs. 10.97) and had a lower likelihood of requiring emergency department visits or hospitalization (7% vs. 15%). These findings underscore the effectiveness of telemedicine in managing acute asthma attacks, enhancing access to primary care, and improving overall asthma management, ultimately reducing the need for urgent healthcare service.(125)

In our survey, the results of the multiple-choice question on the role of telemedicine in asthma attacks reveal that most practitioners see telemedicine primarily as a tool for preventing asthma attacks, with 86.6% selecting "Providing advice to prevent future attacks." A majority also support its role in offering immediate treatment prior to emergency care (70.8%) and assessing the severity of the attack (67.2%). However, fewer practitioners (28%) are comfortable with telemedicine making critical decisions about further treatment in medical facilities. This suggests a reluctance to rely on telemedicine for high-stakes decisions. This likely reflects concerns about telemedicine's limitations in assessing severe cases, where direct in-person evaluation is often deemed necessary for safe and effective decision-making.

6. Telemonitoring of Patients:

Our survey results showed strong support for telemonitoring in asthma follow-ups, with 70% of practitioners in favor. However, 26.4% expressed uncertainty, indicating some reservations. Only 3.6% opposed the use of telemedicine, suggesting that the majority of practitioners are receptive to its potential benefits. Among the practitioners who expressed support for telemonitoring, a substantial majority (92.9%) deemed it appropriate for managing "controlled asthma". A further 57.3% considered it viable for "partially controlled asthma", indicating that telemedicine is perceived as beneficial for patients with less than optimal, but still manageable, asthma control. However, only a small proportion (11.6%) believed telemonitoring was suitable for "uncontrolled asthma". This reflects a degree of caution, suggesting that telemedicine is primarily favored for stable asthma cases, while its use is more limited for patients experiencing significant symptom instability or exacerbations.

In the 2017 study by Hollenbach et al., 41 clinicians from Hartford demonstrated strong endorsement of utilizing inhaler sensors, mobile health applications, and FDA-approved spirometers for asthma monitoring. Physicians, including pediatricians and pulmonologists, acknowledged the substantial benefits of these technologies, especially in managing severe asthma cases. They emphasized the value of real-time, inter-visit data on medication adherence, which enhanced both patient engagement and clinical oversight. Furthermore, clinicians recognized the potential of these tools to inform quality improvement efforts, underscoring their willingness to integrate telemedicine into asthma remote monitoring.(126)

In our survey, physicians expressed varying preferences for telemedicine appointment frequency based on asthma control: 58.8% favored quarterly visits for controlled asthma, 56% preferred monthly check-ups for partially controlled asthma, and 52% supported weekly visits for uncontrolled asthma. Notably, 43.6% felt daily appointments were necessary for more severe cases. These results underscore the adaptability of telemedicine, with physicians tailoring appointment frequency to the severity of asthma, ensuring more frequent consultations for severe cases while reducing the frequency for stable asthma, thus optimizing care delivery.

The results of our survey indicate that physicians view telemedicine primarily as a tool for therapeutic education (92.8%) and monitoring treatment adherence (91.6%) in asthma patients. Secondary applications included managing exposure to risk factors (76.8%) and evaluating asthma control (76%). However, fewer physicians (35.2%) saw telemedicine as suitable for adjusting treatment based on asthma control, suggesting a preference for making such decisions in-person. This reflects the critical role telemedicine can play in ongoing patient management but also highlights some limitations in its use for treatment adjustments.

In a review of literature, Sohrab et al. conducted A systematic search across four databases (PubMed, Web of Science, Embase, and Scopus) and identified 33 clinical trials published between 2005 and 2018 that examined the effectiveness of telemedicine in asthma management, following PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guidelines. Telemedicine was primarily used to enhance patient adherence through reminders and feedback (23 studies), facilitate telemonitoring by utilizing technologies, such as inhaler sensors and digital symptom diaries, and Ease correspondence with healthcare providers (18 studies), provide remote education (6 studies), and offer counseling (5 studies). Overall, telemedicine has been shown to improve symptom control, quality of life, and treatment adherence in asthma care.(102)

A study conducted by Listyoko et al. in 2022, Indonesia analyzed data from telemedicine consultations involving 28 asthmatic patients as part of a community service initiative. The findings highlighted significant gaps in patient knowledge about asthma management. Specifically, 67.86% of participants were unaware of their modifiable risk factors, 96.43% lacked knowledge about a written asthma action plan, and 60.71% were uninformed about asthma-specific exercises. These results underscore the critical need to educate patients on risk factors and empower them with strategies for effective asthma management.(127)

7. Coordination of telemedicine appointments:

Our survey results on telemedicine appointment logistics revealed a preference for third-party involvement, with 58.4% of physicians supporting this option. This suggests that many physicians view telemedicine logistics as a task better managed by external organizations, likely to streamline workflows. In contrast, 41.6% felt that primary care physicians should retain this responsibility, reflecting a preference for maintaining direct control over patient appointments. This division highlights differing perspectives on the most efficient way to integrate telemedicine into healthcare.

8. Training and Preparation Needs:

Our results demonstrate a strong consensus among physicians regarding the necessity for specialized training in telemedicine for asthma management, with 95.2% affirming its importance. The preference for training methods reveals a clear inclination towards flexible, digital formats, as evidenced by the high support for simulation sessions (79.4%) and webinars (73.1%). In contrast, in-person training garnered significantly less interest (34.5%), suggesting that healthcare professionals favor accessible, self-paced online educational methods over traditional face-to-face sessions.

A study conducted in Saudi Arabia from October 2021 to April 2022 by Alqurashi et al, which surveyed 81 healthcare practitioners, found that 64% believe continuous training is essential for the effective implementation of telemedicine. This highlights the critical need for ongoing education to ensure professionals remain proficient in evolving telemedicine practices and technologies.(128)

An article by Paddock et al. (2022) highlights the South Australia Ambulance Service MedSTAR's (Medical Retrieval and Support Team for Advanced Retrieval) education program, which offers an exemplary approach to Telehealth training. The program effectively combines psychometric skills with realistic simulations, to enhance teamwork, communication, technical expertise, and critical thinking. Providing medical and nursing staff with an invaluable opportunity to refine their abilities. This comprehensive training model ensures that practitioners are well-prepared for Telehealth challenges , and capable of delivering improved patient care.(129)

9. Preferred tools and optimal duration of teleconsultations:

In our study, the strong preference for video consultations (83.2%) may reflect its ability to combine immediacy with a visual component, enhancing the clarity of communication and patient engagement. Mobile applications and Sites (53.2%) likely appeal due to their convenience and integrated features, while voice calls (39.6%) offer practicality but lack visual input. The low preference for messaging (18.4%) may stem from its perceived inability to provide detailed, nuanced discussions.

A qualitative study by Donaghy et al. in 2019, Lothian- Scotland, explored the experiences of primary care clinicians on video consultations (VC) via the Attend Anywhere platform. Participants emphasized the benefits of VC, particularly its ability to provide visual cues, reduce the risk of miscommunication common in telephone consultations, offer reassurance and foster better patient comprehension and engagement. Clinicians noted that VCs were more personal, enhancing clinician-patient relationships.(100)

For consultation durations, the predominance of 15–20 minutes (70.4%) indicates a desire for efficiency, balancing thoroughness with time management. The smaller preference for 20–30 minutes (28%) suggests that longer sessions may be reserved for complex cases, while the minimal support for durations exceeding 30 minutes (1.6%) likely reflects logistical constraints and the need for structured, concise interactions in telemedicine. These findings highlight the importance of balancing technical capabilities, patient needs, and resource management in optimizing teleconsultation practices.

Generally, teleconsultations last between 12 to 28 minutes. However, several studies have revealed variations in consultation durations across specialties, reflecting the complexity of cases and patient needs. For instance, pediatric dermatology consultations typically have a median duration of 13 minutes (130), while general medicine consultations average around 12.6 minutes (131), In contrast, oncology consultations tend to be significantly longer, averaging 27 minutes. These distinctions highlight the flexibility of telemedicine in catering to the specific requirements of different specialties, ensuring that consultation times are aligned with the nature of the clinical interaction.(132)

10. Remuneration for Telemedicine Services:

The results reveal strong consensus, with 97.2% of practitioners agreeing that telemedicine consultations should be compensated, underscoring the recognition of telemedicine as a vital component of healthcare. However, opinions on compensation rates varied: the majority (57.2%) advocated for parity between teleconsultations and traditional in-person consultations, likely because both require similar levels of expertise, time, and clinical engagement. This parity also reinforces the legitimacy of telemedicine. A smaller proportion (34.6%) supported lower compensation, while 8.2% argued for higher rates.

In terms of insurance coverage, an overwhelming 88.8% of practitioners affirmed that teleconsultations should be included in health insurance plans, underscoring the widespread belief in telemedicine's role in improving patient access and convenience. This contrasts with 11.2% of respondents who expressed opposition, reflecting some concerns or reservations regarding its integration into standard coverage policies. Overall, these findings suggest a strong professional endorsement of telemedicine, both in terms of fair compensation and insurance coverage, which is essential for its sustained growth and accessibility.

In Salmanizadeh et al.'s review of 28 articles from 2020 to 2022, financial and reimbursement barriers were identified as the primary challenges to telemedicine adoption. Government and private insurance programs generally reimburse telemedicine at rates similar to in-person consultations. In the U.S., Medicaid and private insurers cover telemedicine, while in Australia, Medicare provides partial reimbursement. However, some regions and payers exclude telemedicine or reimburse it at lower rates. Wilson et al. found that private insurance reimbursement for telemedicine was, on average, 36% lower than for in-person services. Medicare and Medicaid primarily cover individuals aged 65 and over, those with disabilities, end-stage renal disease, and low-income or vulnerable populations, with similar restrictions in Australian public health coverage.(133)

11. Additional Feedback Analysis:

These comments provide thematic insights that help contextualize our quantitative and qualitive data on telemedicine adoption in asthma care:

- Improvement in Data Management and Accessibility: "***Create a patient database to allow the consulting physician easy access to the patient's record*** ". This suggestion emphasizes the importance of streamlined, easily accessible patient data for more effective management of asthma through telemedicine.
- Accessibility and Affordability:" ***If teleconsultations were cheaper and more accessible, we could reach a larger demographic of asthma patients"***. This response indicates a concern with the accessibility and affordability of telemedicine for underserved populations, ensuring equitable access to care.
- Tailored Telemedicine Applications: "***Establish specific applications with identifiers for both patients and physicians, tailored to their schedules"***. This suggestion reflects an interest in more personalized, patient-centric telemedicine solutions.
- Public Awareness and Education***: "Raise public awareness about using telemedicine".*** This response suggests a recognition of the need to increase public understanding and trust in telemedicine. Educating the population about the benefits and availability of telemedicine can lead to higher patient engagement and willingness to use these services.

- Complementarity with In-Person Consultations: "**Telemedicine must complement traditional in-person consultations".** This comment emphasizes that telemedicine should not replace in-person consultations but rather serve as a complement. This reflects a balanced view of telemedicine as a tool for expanding access to care, while still recognizing the irreplaceable value of face-to-face interactions for certain aspects of asthma management.

- Skepticism Towards Telemedicine in Asthma Management*: "The management of asthma or other conditions via telemedicine should be optional, not official, as nothing surpasses a clinical examination and direct contact with the patient".* This response reflects a strong opposition to telemedicine, rejecting its use in asthma management. Arguing that physical exams and direct patient interactions are essential and irreplaceable. And that telemedicine should not be considered a viable option at all, as it cannot substitute the depth and quality of in-person consultations. This viewpoint critiques telemedicine as being ineffective and unsuited for asthma management or related conditions.

VII. Study Strengths:

- **Relevance**: Our study represents an innovative and pioneering effort in Morocco, being the first to investigate the applications of telemedicine in asthma management, a field that remains largely unregulated. By exploring doctors' perceptions, this research sheds light on their willingness and concerns regarding telemedicine implementation. These insights are crucial for shaping effective regulations and optimizing the integration of telemedicine into asthma care, while also addressing gaps in existing research and paving the way for future studies on telemedicine applications in managing chronic diseases like asthma.

- **Inclusive Sampling**: With a wide variety of participants from different levels of trainings (interns to specialists) and various healthcare settings (public and private sectors), the sample is inclusive.

- **Comprehensive Coverage of Telemedicine in Asthma Care**: By focusing on various aspects of asthma management, including monitoring, urgent care, and reimbursement, our study offers a comprehensive look at telemedicine in a specific context. It goes beyond basic usage to consider its full potential in improving patient care.

- **Practical Application and Impact**: The study aims to produce actionable recommendations for telemedicine adoption and its use in remote asthma monitoring, offering real-world value to healthcare practitioners, policymakers, and researchers alike. This practical focus boosts the study's impact.

VIII. Study Limits:

1. Methodological limitations:

- **Sampling Bias:** The study relied on voluntary sampling, which may have limited the inclusion of healthcare providers from remote or less accessible areas. This could result in an underrepresentation of practitioners working in these settings.
- **Limited Response Rate**: Although our study included 250 participants, this sample does not fully represent the entire group of healthcare providers involved in asthma care within the Marrakech region. The response rate may have been influenced by factors such as time constraints, unfamiliarity with telemedicine, or a lack of interest in the survey topic.
- **Self-Reported Data:** Data collection was through an online self-administered survey, which may be subject to response bias. Participants may have provided socially desirable answers, especially regarding their use of telemedicine or their views on its effectiveness, leading to over-reporting of telemedicine usage and its perceived benefits.
- **Technological Access and Familiarity:** The survey distribution through Google Forms assumes that participants are familiar with digital platforms, which may have excluded healthcare professionals less comfortable with technology.
- **Survey Design:** The use of Google Forms for data collection may restrict the depth of responses, making it challenging to explore complex perceptions in detail. Additionally, the cross-sectional design of the study prevents longitudinal analysis, limiting insights into how perceptions might evolve over time or how telemedicine implementation impacts asthma management.
- **Few Comparable Studies:** One significant limitation of this study is the absence of a significant body of references or a consensus of publications to which our findings could be directly compared. This lack of existing, comparable studies made it challenging to contextualize our results within established benchmarks, which could have provided a deeper understanding of the study's implications.

2. Generalizability:

- **Regional Scope:** The study was conducted in the Marrakech region, limiting the generalizability of findings to other regions of Morocco or different countries. Cultural, infrastructural, and healthcare system differences may influence telemedicine's perception and implementation in asthma care.

- **Profession-Specific Perceptions:** The sample included general practitioners, pulmonology specialists, and residents, whose perceptions may differ based on training, experience, and exposure to telemedicine. Thus, the results may not represent all medical specialties or healthcare roles.

- **Urban vs. Rural Variations:** While both urban and rural healthcare settings were included, perceptions and use of telemedicine may differ significantly between these areas. The findings may not fully capture the unique challenges and opportunities to the applicability of the results faced by healthcare professionals in rural areas.

- **Lack of experience:** The limited experience with telemedicine in daily medical practice among Moroccan practitioners may have influenced their responses, particularly regarding its perceived feasibility and effectiveness. This lack of familiarity could have introduced bias or uncertainty, potentially limiting the depth of insights gained about telemedicine's role in asthma management.

IX. Recommendations:

1. For practioners:

Enhance Telemedicine Training: Comprehensive training for healthcare practitioners on telemedicine platforms, tools, clinical guidelines and ethical practices should be adopted to improve the quality and reliability of remote asthma care.

Prioritize Patient Education: Physicians should ensure patients are well-informed on the use of telemedicine tools, such as apps and wearable devices, and trained to monitor symptoms, adhere to medication regimens, and recognize signs of emergencies effectively.

Recommend Individualized Care Plans: Practitioners should tailor telemedicine strategies to each patient's unique needs, considering factors such as age, comorbidities, and asthma severity. This personalized approach can improve the effectiveness of remote monitoring and treatment.

2. For healthcare policy:

Promote Reimbursement Parity: Policymakers should ensure equitable reimbursement for telemedicine services, similar to in-person visits, particularly for chronic conditions like asthma. This would promote broader adoption of telemedicine by healthcare providers and patients.

Strengthen Infrastructure Support: Governments should invest in enhancing the digital infrastructure, particularly in underserved and rural areas, to improve access to telemedicine services. This includes ensuring high-speed internet availability and the provision of telehealth equipment.

Establish Clear Regulations: Policymakers need to create clear, standardized regulations for telemedicine practices, including licensure, patient safety, and malpractice liability, to ensure consistency and patient protection across telemedicine services.

Public Awareness Campaigns: Educate patients on telemedicine's benefits and address skepticism about its quality through strategic campaigns. These should include partnerships for TV, radio, and online advertisements, social media outreach, and distributing educational materials such as brochures and videos via clinics, pharmacies, and hospitals.

Expanding the Telemedicine Team: Incorporate a broader spectrum of healthcare professionals beyond traditional roles for instance nurses, respiratory therapists, rehabilitation specialists, speech-language therapists, dietitians, social workers...etc.

3. For future research:

Conduct studies assessing the acceptability and support of telemedicine in asthma care, with a focus on pediatricians who frequently manage this condition. Their role often involves intensive follow-up and significant effort, making them key stakeholders in evaluating telemedicine's effectiveness. On the other hand, research should also examine the acceptability of patients with asthma on managing their condition through telemedicine services.

Research should explore patient satisfaction and compliance with telemedicine platforms and its impact on medication adherence and overall asthma management. Understanding these factors will be crucial for improving patient engagement and outcomes.

Future research should prioritize the development and evaluation of cutting-edge telemedicine technologies, including AI-powered monitoring tools and virtual care systems, to enhance the accuracy and efficacy of asthma management.

Undertake Simulation studies, generating recommendations for a set of fake patients, validated by medical experts, could be a useful mitigation action.

Initiate national or local studies to investigate the cost-effectiveness of telemedicine in asthma management, focusing on potential savings from reduced hospitalizations, emergency visits, and transportation expenses. This will help assess and promote the broader economic benefits of telehealth.

Further research should focus on evaluating the long-term effectiveness of telemedicine in asthma care, particularly in reducing emergency room visits, hospitalizations, and improving overall patient health outcomes. Longitudinal studies are needed to assess whether telemedicine continues to provide sustained benefits in reducing healthcare utilization and improving asthma management over time.

Conclusion

In conclusion, this thesis has explored the multifaceted role of telemedicine in the management of asthma, a chronic condition with far-reaching implications for global healthcare systems, individual well-being, and economic stability. The high prevalence and significant morbimortality of asthma, along with its substantial financial burden, underscore the critical need for innovative, scalable solutions to enhance its care. Telemedicine, with its expanding applications across medical disciplines, holds considerable promise for improving accessibility, efficiency, and patient outcomes in asthma management.

Through a descriptive analysis of healthcare professionals' perceptions, this study examined the acceptability, perspectives, and concerns regarding the integration of telemedicine into asthma care. Particular emphasis was placed on its potential to enhance remote monitoring, improve patient outcomes, and enable timely interventions during asthma exacerbations. The findings demonstrate broad support for telemedicine, especially in facilitating remote patient monitoring, conducting follow-ups, and advancing patient education. Expert opinions and literature analysis further highlighted the practicality and efficacy of telemedicine while emphasizing the need for specialized training and the development of advanced telecommunication tools to optimize its implementation.

While telemedicine offers a transformative opportunity to address the complexities of asthma management, several barriers and enablers to its widespread adoption remain. These include inadequate infrastructure, lack of experience, concerns over liability and privacy, the absence of standardized remuneration and insurance frameworks, and the need for robust legal and ethical guidelines. Overcoming these challenges is paramount to unlocking the full potential of telemedicine in chronic disease care.

By Synthesizing the results, this study offers targeted recommendations to support the integration of telemedicine in asthma management. These include the development of practitioner-specific training programs, policy reforms to ensure equitable remuneration, and the establishment of comprehensive legal frameworks to mitigate liability risks. Additionally, the study advocates for continued technological innovation and long-term evaluation of telemedicine's effectiveness in chronic disease care.

Despite its contributions, this research acknowledges certain methodological limitations and calls for further studies to explore telemedicine's long-term outcomes and broader applications. As the healthcare landscape evolves, integrating telemedicine into asthma management strategies offers a compelling pathway to enhance accessibility, strengthen patient engagement, and reduce healthcare costs, ultimately improving health outcomes on a global scale.

ABSTRACT

Abstract

Introduction: In an age characterized by swift technological advancements and an increasing need for accessible healthcare, telemedicine has emerged as a revolutionary approach to managing chronic conditions such as asthma. This study investigates the effectiveness of telemedicine in enhancing asthma care through continuous monitoring, timely treatment modifications, and improved patient outcomes. The research objectives are threefold: to evaluate healthcare professionals' perspectives on telemedicine in asthma care, to offer evidence-based recommendations for remote monitoring, and to promote the incorporation of telemedicine into standard asthma management practices.

Participants and method: Our study is a descriptive cross-sectional analysis aimed at assessing the perceptions of general practitioners, pulmonology specialists, and residents in the Marrakech region on the application of telemedicine in asthma management. We collected data using an anonymous questionnaire via Google Forms, with responses analyzed in Microsoft Office Excel 2019.

Results: A total of 250 participants contributed to this study, the majority of whom were general practitioners (82%) operating within the public sector. Notably, (61.6%) reported prior experience with telemedicine. A substantial majority (92.4%) acknowledged the civil and professional liability associated with its use. While (46.4%) expressed reservations about employing telemedicine for acute asthma exacerbations, (70%) endorsed its role in telemonitoring for asthma follow-ups. Furthermore, (95.2%) underscored the critical need for specialized training, and (97.2%) affirmed that telemedicine consultations warrant appropriate remuneration. Regarding insurance, (88.8%) advocated for the inclusion of teleconsultations within health coverage schemes.

Conclusion: This thesis has explored the pivotal role of telemedicine in advancing asthma management, underscoring its capacity to enhance accessibility, efficiency, and patient outcomes. While healthcare professionals expressed strong support for telemonitoring and follow-up care, significant challenges remain, including infrastructural deficiencies, legal and privacy concerns, and the absence of standardized frameworks for remuneration and insurance. Overcoming these barriers necessitates the implementation of specialized training, the establishment of robust ethical and legal guidelines, compensation and sustained technological innovation. By offering evidence-based recommendations, this study highlights telemedicine's transformative potential in asthma care and its broader implications for equitable and cost-effective healthcare, while emphasizing the need for further research to assess its long-term efficacy and wider applicability.

Résumé

Introduction : À une époque caractérisée par des avancées technologiques rapides et une demande croissante pour des soins de santé accessibles, la télémédecine émerge comme une approche novatrice pour la prise en charge des maladies chroniques, notamment l'asthme. Cette étude se penche sur l'efficacité de la télémédecine dans l'amélioration des soins liés à l'asthme, en mettant l'accent sur le suivi continu, les ajustements thérapeutiques en temps opportun et l'amélioration des résultats pour les patients. Les objectifs de cette recherche sont triples : évaluer les perceptions des professionnels de santé sur l'utilisation de la télémédecine dans la gestion d'asthme, de proposer des recommandations fondées sur des données probantes pour le suivi à distance, et de promouvoir son intégration dans les pratiques standards de prise en charge de l'asthme.

Participants et méthode : Notre étude est une analyse descriptive transversale visant à évaluer les perceptions des médecins généralistes, et des spécialistes en pneumologie de la région de Marrakech, concernant l'utilisation de la télémédecine dans la gestion de l'asthme. Les données ont été collectées à l'aide d'un questionnaire anonyme distribué via Google Forms, et les réponses ont été analysées à l'aide de Microsoft Office Excel 2019.

Résultats : Un total de 250 participants a contribué à cette étude, dont la majorité (82 %) étaient des médecins généralistes exerçant dans le secteur public. Parmi eux, (61,6 %) ont déclaré avoir déjà utilisé la télémédecine. Une large majorité (92,4 %) a reconnu les implications de la télémédecine sur leur responsabilité civile et professionnelle. Bien que (46,4 %) aient exprimé des réserves quant à son utilisation lors des exacerbations aiguës de l'asthme, (70 %) ont approuvé son rôle dans le suivi et la télésurveillance. Par ailleurs, (95,2%) ont souligné l'importance cruciale d'une formation spécialisée, et (97,2 %) ont affirmé que les consultations de télémédecine méritaient une rémunération appropriée. Concernant la couverture sanitaire, (88,8%) des répondants ont soutenu l'inclusion des téléconsultations dans les régimes d'assurance.

Conclusion : Cette thèse a examiné le rôle crucial de la télémédecine dans l'optimisation de la gestion de l'asthme, en mettant en évidence son potentiel pour améliorer l'accessibilité, l'efficacité et la qualité des soins prodigués aux patients. Bien que les professionnels de santé aient exprimé un soutien significatif pour le suivi à distance, plusieurs défis majeurs subsistent, notamment des infrastructures insuffisantes, des préoccupations juridiques et éthiques, des questions de confidentialité, ainsi que l'absence de cadres standardisés pour la rémunération et l'assurance. Afin de surmonter ces obstacles, il est impératif de mettre en œuvre des formations spécialisées, d'établir des lignes directrices éthiques et juridiques robustes, d'assurer une compensation équitable et de promouvoir une innovation technologique continue. Cette étude formule des recommandations concrètes, étayées par des données probantes, incluant notamment la nécessité de poursuivre des recherches afin d'évaluer l'efficacité à long terme de la télémédecine dans l'asthme. Ces propositions s'inscrivent dans une perspective d'amélioration continue des pratiques de santé, pour un système de santé plus équitable, innovant et durable.

ملخص

المقدمة:

في عصر يتميز بالتقدم التكنولوجي السريع والحاجة المتزايدة إلى رعاية صحية ميسورة ومتاحة، برز التطبيب عن بعد كنهج ثوري لإدارة الأمراض المزمنة مثل الربو. تهدف هذه الدراسة إلى تقييم فعالية التطبيب عن بعد في تحسين رعاية مرضى الربو، مع التركيز على المراقبة المستمرة، التعديلات العلاجية الفورية، وتحسين النتائج الصحية للمرضى. تتلخص أهداف البحث في ثلاثة محاور رئيسية: تقييم تصورات المهنيين الصحيين بشأن تطبيق التطبيب عن بعد في إدارة الربو، تقديم توصيات قائمة على الأدلة لاستخدام التكنولوجيا في المراقبة عن بعد، تعزيز دمج التطبيب عن بعد كجزء من الممارسات المعتمدة لإدارة الربو.

المشاركون والمنهجية:

تعد هذه الدراسة وصفية مقطعية تهدف إلى تقييم تصورات الأطباء العامين، أطباء الجهاز التنفسي، والمتدربين في منطقة مراكش حول استخدام التطبيب عن بعد في إدارة مرض الربو. تم جمع الإجابات باستخدام استبيان إلكتروني بدون كشف الهوية عبر منصة Google Forms ، وتم تحليل الردود باستخدام برنامج Microsoft Office Excel 2019 .

النتائج:

شارك في الدراسة 250 شخصًا، معظمهم (82%) من الأطباء العامين العاملين في القطاع العام. أشار (61.6%) من المشاركين إلى امتلاكهم خبرة سابقة في مجال التطبيب عن بعد. كما أقر (92.4%) بأثر التطبيب عن بعد على المسؤولية المدنية والمهنية للأطباء. أبدى (46.4%) ترددًا بشأن استخدامه لإدارة نوبات الربو الحادة، بينما دعم (70%) دوره في المتابعة عن بعد. بالإضافة إلى ذلك، أكد (95.2%) على أهمية التدريب المتخصص في هذا المجال، وأيد (97.2%) ضرورة تعويض الاستشارات عن بعد بشكل مناسب. أما فيما يتعلق بالتغطية التأمينية، فقد دعا (88.8%) من المشاركين إلى إدراج الاستشارات عن بعد ضمن خطط التأمين الصحي.

الخلاصة:

تناولت هذه الأطروحة الدور المحوري للتطبيب عن بعد في تحسين إدارة مرض الربو، مسلطةً الضوء على إمكانياته في تعزيز الوصول إلى الرعاية الصحية، رفع كفاءتها، وتحسين نتائج المرضى. على الرغم من الدعم الكبير الذي أبداه المهنيون الصحيون للتطبيب عن بعد في مجالات المراقبة والمتابعة، إلا أن هناك تحديات بارزة مثل ضعف البنية التحتية، المخاوف القانونية والأخلاقية، وعدم وجود أطر معيارية للتعويض والتأمين. يتطلب التغلب على هذه العقبات تنفيذ برامج تدريب متخصصة، وضع خطوط توجيهية قانونية وأخلاقية متينة، وضمان تعويض عادل مع استمرار الابتكار التكنولوجي. تقدم هذه الدراسة توصيات قائمة على الأدلة لدعم التطبيب عن بعد في إدارة الربو، مع الإشارة إلى الحاجة إلى مزيد من البحث لتقييم فعاليته على المدى الطويل وتوسيع تطبيقاته.

Appendices

Questionnaire destiné aux médecins généralistes, internes et pneumologues de la région de Marrakech sur l'utilisation de la télémédecine pour la prise en charge des patients asthmatiques.

Informations générales :

1-Êtes-vous ?

- ☐ Médecin généraliste (y compris interne au CHU / périphérie région de Marrakech)
- ☐ Pneumologue (y compris résident(e))

2-Votre secteur de travail?

- ☐ Public
- ☐ CHU Med 6 Marrakech
- ☐ Privé

3-Si Public, veuillez citer votre lieu d'exercice : (par exemple CHP al Haouz ...)

……

4- Recevez-vous des asthmatiques en consultation / aux urgences ?

- ☐ Oui
- ☐ Non

5-Si oui, à quel rythme ?

- ☐ Moins de 5 patients par semaine
- ☐ Entre 5-10 patients par semaine
- ☐ Plus de 10 patients par semaine

6- Avez-vous déjà utilisé la télémédecine dans votre pratique médicale ? (Y compris téléphone et WhatsApp)

- ☐ Oui
- ☐ Non

7-Pensez-vous que la télémédecine engage la responsabilité civile et professionnelle du médecin?

- ☐ Oui
- ☐ Non

Prise en charge d'une crise d'asthme :

1- Êtes-vous pour la gestion d'une crise d'asthme par télémédecine ?

- ☐ Oui
- ☐ Non
- ☐ Peut-être

2- Si oui ou peut-être, quel type de crise ? (Choix multiples possible)

- ☐ Crise légère
- ☐ Crise modérée
- ☐ Crise sévère

3- Dans quelle mesure pensez-vous que la télémédecine peut jouer un rôle dans la prise en charge d'une crise d'asthme ? (Choix multiples possible)

- ☐ Evaluation de la sévérité de la crise
- ☐ Traitement immédiat sur le lieu de la crise avant la venue aux urgences
- ☐ Décision de traitement ultérieur en milieu médical (si nécessaire)
- ☐ Conseils pour prévenir des crises futures

Télé-suivi d'un asthmatique :

1- Êtes-vous pour l'utilisation de la télémédecine pour le suivi des asthmatiques ?

- ☐ Oui
- ☐ Non
- ☐ Peut-être

2- Si oui ou peut-être, quels types d'asthmatiques ? (Choix multiples possible)

- ☐ Contrôlés
- ☐ Contrôlés partiellement
- ☐ Non Contrôlés

3-D'après vous qui devrait être chargé de la gestion des rendez-vous de télémédecine ?

- ☐ Le Médecin traitant
- ☐ Une Personne tiers

4-À quelle fréquence devraient être programmés les rendez-vous en télémédecine pour un asthmatique ?

	Quotidien	Hebdomadaire	Mensuel	Trimestriel
☐ Asthme contrôlé				
☐ Partiellement contrôlé				
☐ Non contrôlé				

5- Comment voyez-vous l'utilité de la télémédecine en télé suivi des asthmatiques ? (Choix multiples possible)

- ☐ Évaluer le contrôle d'asthme
- ☐ L'ajustement du traitement selon le degré de contrôle
- ☐ Vérifier l'observance
- ☐ L'éducation thérapeutique
- ☐ Gérer l'exposition aux facteurs de risque : allergie, infections, activité professionnelle, sportive …

<u>Formation et préparation</u> :

1-Pensez-vous qu'une formation spécifique est nécessaire pour les professionnels de la santé impliqués dans la gestion d'asthme par télémédecine ?

- ☐ Oui
- ☐ Non

2-Si oui, quels types de formations ? (Choix multiples possible)

- ☐ Webinaires
- ☐ Des formations en présentiel
- ☐ Une conduite à tenir/ un manuel détaillée mis à la disposition des médecins
- ☐ Des séances de simulation

Outils et technologies:

1-Quelles modalités/outils privilégiez-vous dans le cadre de la télé communication avec les patients ? (Choix multiples possible)

- ☐ Appels vocaux
- ☐ Appels vidéos
- ☐ Messages
- ☐ Applications mobiles et Sites internet

2- Quelle devrait être la durée estimée nécessaire et suffisante pour une consultation à distance?

- ☐ 15 à 20 min
- ☐ 20 à 30 min
- ☐ 30 à 40 min

La Rénumération:

1-Pensez-vous que les médecins devraient être rémunérés pour leur service de télémédecine ?

- ☐ Oui
- ☐ Non

2-Si oui pour la rémunération, Estimez-vous qu'elle devrait être ?

- ☐ Moins qu'une consultation classique
- ☐ Équivalente à une consultation classique
- ☐ Plus qu'une consultation Classique

3-Pensez-vous que les mutuelles devraient inclure la téléconsultation dans leur couverture ?

- ☐ Oui
- ☐ Non

Avez-vous des suggestions ou des commentaires supplémentaires sur l'optimisation de la gestion d'asthme par télémédecine ?

.....

Nous vous remercions pour votre participation. Vos réponses contribueront à approfondir la compréhension des perspectives des professionnels de santé concernant l'acceptation et le soutien de la télémédecine dans la gestion globale de l'asthme, notamment dans le suivi à distance et la prise en charge des crises.

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قسم الطبيب

أقسِم بالله العَظِيم

أن أراقبَ الله في مِهْنَتِي.

وأن أصُونَ حياة الإنسان في كآفّةِ أطوَارهَا في كل الظروف والأحَوال باذلة وسْعِي في انقاذها مِن الهَلاكِ والمرَض والألَم والقلَق.

وأن أحفظ لِلنَاس كرَامَتهُم، وأستْر عَوْرَتهُم، وأكتمَ سِرَّهُمْ.

وأن أكونَ عَلى الدوَام من وسائِل رحمة الله، باذلة رعايتي الطبية للقريب والبعيد، للصالح والطالح، والصديق والعدو.

وأن أثابر على طلب العلم، وأسَخِّرَه لِنَفْع الإِنْسَان لا لأذاه.

وأن أُوَقّرَ مَن عَلَّمَني، وأُعَلّمَ مَن يَصْغرَني، وأكون أختا لِكُلّ زَميلٍ في المِهنَةِ الطِّبّيَة مُتعَاونِينَ عَلى البرّ والتقوى.

وأن تكون حياتي مِصْدَاق إيمَاني في سِرّي وَعَلانيَتي، نَقِيَّة مِمّا يُشينهَا تجَاهَ الله وَرَسُولِهِ وَالمؤمِنين.

والله على ما أقول شهيد

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الأطروحة

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المزدادة في 26/01/1998 بمراكش

لنيل شهادة الدكتوراه في الطب

الكلمات المفتاحية

الطب عن بُعد – تدبير حالات الربو – آراء وتصورات الممارسين

اللجنة

السيد	**ت. أبو الحسن** أستاذ في طب التخدير والانعاش	**الرئيس**
السيدة	**س. أيت بطاهر** أستاذة في طب الجهاز التنفسي	**المشرف**
السيد	**م. بو الروس** أستاذ في طب الأطفال	**الحكام**
السيد	**أ. بن جلون حرزيمي** أستاذ في طب الجهاز التنفسي	
السيدة	**ف. بنوي** أستاذة في طب الأطفال	