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The factors that impact the adoption and Usage of Telemedicine in Chronic Diseases: Systematic Review

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Abstract

Chronic diseases are one of the most common diseases that pertain to a large number of people. Most people suffer from one or chronic diseases, such as diabetes, heart failure, rheumatoid arthritis, cancer, and others. According to a recent statistic, 9% of Jordanian have at least one type of chronic disease; it is a high percentage for a country of limited resources like Jordan. Chronic diseases are costly to manage; the cost is not only associated with the treatment alone but also to monitoring patients, healthcare professionals labor, and continuous lab testing. During the past few years, the world witnessed a significant increase in the number of mobile Health users. This increase also translated into an increase in using Telehealth services. This paper aims to conduct a systematic literature review of the different adoption factors of Telemedicine for chronic diseases. We provide an analysis and a synthesis of recently published research in the past ten years. We follow the methodological literature review proposed by Ramey and Rao to examine and extract related scholarly work. By providing a thematic analysis of related literature, we classify the current research into the main themes of the Telehealth in the chronic field. We also develop a taxonomy of positive and negative factors that influence Telehealth. We also highlight the main limitations and gaps in the literature to guide future research.

Most of people suffers from one at least of chronic disease, such as diabetes, heart failure, rheumatoid arthritis, etc. this disease is suffering it people who older, adults, and the children. Chronic disease is one of the case the death and disability in USA, 133 million of people at least having the one chronic and cost to treatment the chronic is $ 659 billion [13].

Chronic disease is an illness take huge cost money from the government, most of the people are not have optimal solution to control of their disease or not received effective treatment at the appropriate time, we solve this problem by using the primary care, after that shifting the case to hospital to take a care from the specialists or disease management programming [2]. The chronic disease is increasing in the low and middle income countries because it less having hospital or hospital is far [11]. this is reason that make the government to goes to use the Telehealth technology.

We must use a new technology that be effective and accurate will help the

patient and management of chronic disease to remote the disease and take the effective solution [4]. Telehealth or telemedicine is developed very quickly to remote patient in other place or tele-monitory is used communication technology to monitored and transmitted data which related the patient status. We can use any technology that related with illness such as the blood pressure, blood sugar, hart rate etc. [3], because it growing quickly by using technology that help remote delivery of health care, it is alternative to visit hospital for patient with having a chronic disease [7] and it has been used in large area to help with intervention across many aspects of healthcare. It includes technology that is wireless, mobile, or wearable such as the sensors, medication pumps, or wristbands that monitor physical activity. the telehealth includes thousands of health apps designed for mobile devices [5]

There is interest of the telehealth which use the technology such as the mobile to support the self-management care and the remote delivery of health [7]. The telehealth that allows the patient to quickly known recognize and receive the treatment and taking it [27]. Some method giving the patient knowledge, confidence and skill of their condition for the self-management [14]. Though the low and middle income can use telehealth but there is have a digital divided like the program which used [5].

Intervention of the web communication is an effective tool that can use with patient to check them self in primary care, the chronic disease is one of the primary care [12]. Another tool is using the tele monitoring platform to monitor the older people who living alone [38].

In the past years, some of research study the effect of the chronic disease in the people and how the using of the chronic disease will be improving it by using programing or sensor in the home, and what is the how can taking the best treatment of the illness. The main objective of this study was to conduct a systematic review of the existing research, analysis and synthesis it. This study also identifies future research of this topic. We aim to answer these question:

RQ1: what is the positive and negative factor for adoption of the telehealth on chronic disease?

RQ2: what is the gap of that topic in the last ten years?

RQ3: what is the feature research?

To answer of this question, we conducted a systematic review to determine the research papers which related to adoption telehealth on the chronic disease. Our systematic review is divided it to the three phrases, the plan, the conduct and the extract data.

As the result of this systematic, it contains answer of the question about the telehealth chronic disease and what is the unsolved problem and need to solve in future research. We conduct the multi-dimensional review and analysis by classification research on the factor positive or negative.

The contributions of this paper discuss using the disease management programming or the using telehealth programming to solve the chronic disease. The telehealth programming is recently appearing to solve problems of chronic disease in the another place. We give the factor of the telemedicine with chronic disease from the researches which is the positive or negative, we design framework themes to the factor finally we find the limitation of the exiting research.

Methodology

In this paper, we depended the Ramey and Rao's methodology to write Systematic review. In this review we divided it to the three phrases, the plan, the conduct and the extract and synthesis. Figure 1 show that phrases.

the plan phrase

determine topic and research question

The conduct phrase

Determine year, keyword, database, and include and exclude criteria

the extract and synthesis

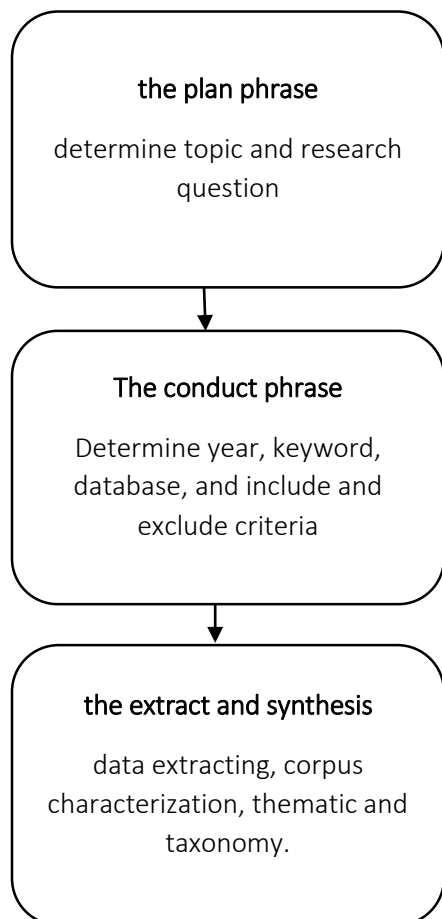data extracting, corpus characterization, thematic and taxonomy.

Fig.1 the phrase of systematic review

In the planning phrase aimed to defining the research of themes and the answer of our question that will be founding at the end of research, we study the chronic disease and the telemedicine and aim of this review is adoption factor of telemedicine in chronic diseases, and the gabs and limitation of the recently researches.

the second phrase, we conduct comprehensive search of all research, we study the telehealth with chronic disease to search it in three databases science direct, JAMIA (OXFORD) and PubMed to collect all the paper which related telemedicine in chronic diseases. We search it by using these term: factor telemedicine of chronic disease, Telemedicine of chronic disease, E-health of chronic disease and Electronic health of chronic disease. We focus to the researches paper which publication between 2009 and 2019, that period the smart phone was using in widespread. Table 1 showing the paper which founding after we searching and removed the paper which not English.

Keyword	Science direct	JAMIA (OXFORD)	Pub Med
factor telemedicine of chronic disease	123	31	52

Telemedicine of chronic disease	137	37	1466
E-health of chronic disease	238	435	196
Electronic health of chronic disease	117	216	1146
Total	615	719	2860

Table 1 showing the paper English we founding.

The next step, we define a strong rule to search term and keyword, to ensure we collect accurate and comprehensive list of paper. After that we compile the output of the research. We founding after search in the database 4214 paper. Firstly, we apply the criteria in the paper include only the paper which written in English, we exclude the 20 paper which written in other language to become the papers 4194. The second criteria are excluding the duplicate citation 574 paper removed to become the paper 3620. The third criteria are excluding based on outlet which is not paper like book, book chapter, or no full text available. We exclude 14 paper to become the paper 3606 paper. The four criteria are based on title and abstract, we based to exclude with using our selection rule related the title and abstract describe later, we exclude 3200 papers to become 406 paper. After that we applied the final criteria by exclude based on the full text, we using our selection rule describe later, we exclude 368 paper to become 38 paper, Fig.2 showing the stage to include and exclude criteria the paper.

We study the 38 paper that met the research criteria that we set and which related our topic to use for analysis and extraction the information to produce model.

The selection rule based on title and abstract:

1.Not telemedicine (all paper which discuss the chronic disease in hospital or not remoting)

2.Not chronic (all paper which discuss the one illness in chronic disease not in general).

3.Not telemedicine chronic (all paper discuss the one of our object, the chronic or telemedicine)

4. Not Electronic health

Excluded based on full-text:

1.Not telemedicine chronic (all paper discuss the one of our object, the chronic or telemedicine)

2.Not Electronic health chronic (all paper discuss the one of our object, the chronic or telemedicine)

3.Not chronic in general (all paper which discuss telemedicine and specific with one illness in chronic disease not in general)

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Initial search N=4214
        │
        ├──────────────▶  Not English paper n= 20
        ▼
English manuscript N=
      4194
        │
        ├──────────────▶  Duplicate citations
        ▼                      (n=574)
Unique citation screened
       (n=3620)
        │
        ├──────────────▶  Exclude based on outlet
        ▼                      N= 14
Related outlet N=3606
        │
        ├──────────────▶  Citation excluded on title
        ▼                   and abstract (n=3200)
Screening of full-text
       (n=406)
        │
        ├──────────────▶  Execute based full paper
        ▼                      N=368
Final paper N=38
```
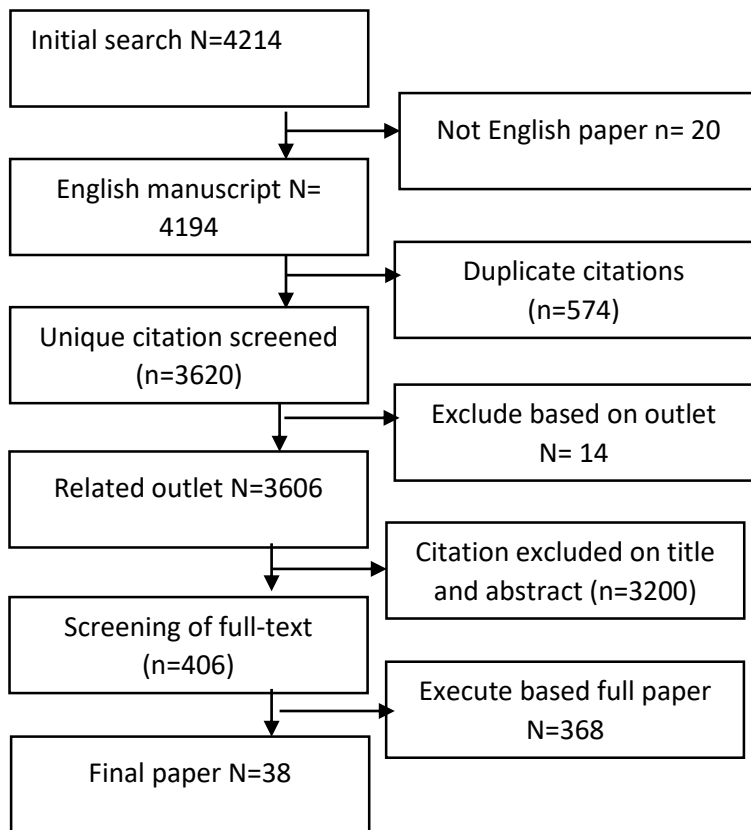
Fig.2 showing the stage to include and exclude criteria the paper.

We study the 38 paper which founded to extract data and synthesis by study the article depth, the main goal of extract process to serve our research goal and question, and the main goal of synthesis is to take a summary of the article. we use the data which extract to enable the identify the positive and negative factor which effect to the chronic disease and to identify the gabs of the researches.

Results and Discussion

After we select the 38 papers we based on include and exclude criteria which determined above. We study final phrase of systematic review, in order to achieve the goal of the research and provide the answer to the aforementioned research question. We divided it to four steps:

1. Data extraction
2. Corpus characterization
3. Thematic analysis
4. Taxonomy development

Data extraction: In this step we collected the final set of 38 article to extract data to find the answer of the question, emphasis was placed on the research problem, research objective, methodology, major finding, factor positive or negative and the gaps or limitation. We extracted data and recorded it in the excel sheet. After that we determine the factor positive or negative to reduce the human error by reviewed the article separately.

Corpus characterization: we characterized and reviewed the corpus of 38 article according to the publishing and methodology.

Publishing: We select the study which published from the 2009 to 2019. the table 2 is showing distribution of the published year of the 38 article researches. The majority of paper is published in 2017, we study the 8 paper. Where we can say that during this period smartphone is spared, that mean the using telehealth also is spared.

Year	Total
2010	1
2011	6
2012	1
2013	5
2014	3
2015	4
2016	4
2017	8
2018	4

Table 2: show the paper select published.

Methodology: We divide all paper with the positive factor and negative factor, after that we find the theme to the positively and negatively, using the telehealth or m-heath with chronic disease.

Thematic analysis: after we study 38 paper and analysis it, we write it in the excel in some of feature, the summarization of paper is containing a problem of paper, objective of paper method using, the major finding the positive or negative factor, sample of the paper and the gabs of the research. The next step we combine it in to groups.

A: We identify the factor positively in eight theme, this is a summary of the themes:

Safety: the safety is applying when use technology to remote the patients such as the blood pressure, blood sugar, hart rate. Like that technology help the patients to known that happen error in themselves and must take the drug or do something to reduce that error, these technology sometime connect with the physician, that make the patient asked their provider questions and make the provider remote their patients when it transmits data that related with status statuses patients, and detection the illness or the technical event [3], one of this technology which apply the safety of the patient and its effect the patients' healthcare treatment and intergeneration of biomarker monitory which connect with patient m-heath by sending a message [4].

Reduce hospitalization: we can reduce the hospitalization by using the telehealth technology that reduce number of patient which visiting the office or length of the stay of the hospital, that make patients receive the services in home with rest and can complete their jobs with cut out [3]. Some people prefer the bleakness themselves and not connect with other people like the veterans who having a chronic illness, these people are used many programming to reduce hospital, the care coordination home health CCHT is one of this program which use to promote in home health by using message device in home [5]. Another program tele monitoring TM by using the video consultation and provide intervention to provider quickly knowledge if happen some error in patient's body and usually it prevents hospital and it is not using to reduce hospital only but sometime it alternative visit respiratory by reduce cost [6].

High satisfaction using m-health: we can apply this theme when patient is using the m-heath easy and effective. The satisfaction using m-health with patients by using the technology such as phone based, email or social media. The patients which used the telehealth not only the younger used it to access to hospital we find the older people interested to use the technology. Most of people is prefers the email or phone based to used telehealth. We used it in NHs Direct and take positively experience with telehealth [7]. We can measure satisfaction by using interactive websites on the internet to connect the patients with their provider increasing that connections are essay,

access and particularly interesting for patients who suffer the chronic disease. This web is given a positive effective to use it for effective web interactive like QUOTE [8]. Other way is measures the satisfaction is by divided patients in three groups to intervention the first used usually care, the second is e-learning and the final part is used the e-learning and workshops together [9]. Sometime the satisfaction is dependent to the infrastructure which provided the patients to training and support the program for caregiver CG, like this program is improve confidence, lower strain and burden for the patient like veterans enrolled themselves in the home telehealth HT or not [10].

Effect using on chronic diseases: used these program that effect usability on chronic disease is positively in low- and middle-income countries LMIC outcome, the LMIC is used an effective intervention like used the cell phone voice and text massages, the effective of this positively impact and reduce the cost in these countries[11], some intervention is used the web-based page only or combine it with workshops to treatment for patients who suffer from chronic disease, but we must help the order patient to use a computer. After we applied this process we find the patient who training to use these website having a positively impact with it [12] one of these web pages that is using open source electronic health record EHR that helps patient to save their data which related with disease such as community health center CHC and it ability to modify the EHR with used CHC to help the chronic care patient [13].

Improve heath outcome: we will improve the outcome of health by reduce the mistake that happen between patients and provider, and reduce the cost and timeless which need to appointment etc. we using the interactive website like QUOTE, that will help to connect patient with their provider [8], intervention that need in the group who used the e-learning and workshops in website also improve the outcome, when these group having a communication between them and their provider [9], sometime we find the intervention such as how can measurement of clinical outcomes across patients with using protocol [15], e-health tools which is the electronic health tool also can measure the outcome and improvement the connections between Provider and patient interaction [14]. The intervention is need to sharing ideas between provider and patient and what is the cause that is happen to make the error in patients [16], the scorecard is used to electronic health and it is away to improvement the outcomes with online and mobile content, it is helping to prevent from chronic disease and help patient to do the health lifestyle by sending data that related with lifestyle of the patient and allow to the patient score himself or any person to understand the information that give by scorecard to give a recommendations to the patients[17] and we can compute the degree of usability the telehealth to known the efficiency of virtual education by used many tool of telehealth such as telephone, web based, video conference and television. These intervention is give positive and also

improve the outcome which is similar the control condition [18].

Enhance self-management: using the e-health tool which support self-management such as using chronic care model CCM that helping the patient to knowledge information related with their body to quickly treatments and helping them by giving a recommendation to enhance self-management [14]. We can use technology tool to communication with other patients, education from them or from the experiment, also facilitate adherence is used to monitoring and easy management the chronic disease [19], many programming help the patients to self-management with using telehealth the chronic disease self-management program CDSMP which used the single group and multi-groups of patients, single which the patients is used one website of telehealth to connect with other patients, multi groups which the patients is used many website to connect with other patients, that program will improvement the self-management and self-efficacy [20]. We find development and evaluate application like PHR and EMR [21].

Acceptability: the most of patients is prefers used the e-learning and workshop this lead the intervention is give our positive to usability and will increase in clinical accessibility quickly and efficiently [9], the patient who used the scorecard find it is very accessible to their data quickly and essay which is founding it in online and content [17] also used the single sites and multi-sites group is used to making accessibility is a good [22] we can access to mobile technology with telehealth in poor regions essay [23], intervention of the data make the access is essay and quickly and the data is very quality [28] and sometime we improve timeliness and accessibility of healthcare by using some resource [40].

Improve quality and effective: improve quality of life style [5][8], virtual education was so effective [18], 3C patients after development the e-health system to use with all patients. Improve efficient of use Telehealth technology [25], number out patient's attendance high quality of Telemedicine [21]. We can forecast the probability distribution of pain of the patient [27] accurately measure technology [29] we use the tele monitoring technology to improve care and positive impact of older patient [38] this monitoring need as specific at time [39].

B: we identify the factor negatively in four themes, this is a summary of the theme:

Cost apply: The Telehealth have high cost to care to apply it need a new technology and new method connections between the technologies [3], tele monitoring also having high of cost to monitoring the all patients, all disease and all reactions from the drug [30]. Which that the cost of each patient in home monitoring with alone [32], prevention action to decrease the illnesses from chronic disease [33]. Most of program not compute the reliable of cast like the RPM program is not having reliable cost estimates [34].

Failed to the improve intervention apply: sometime we find the deference

between telemedicine and translational with placebo test [26]. The CHANGE intervention failed to improve the exploring treatment intensification [35]. Also filed with attempts using the tele monitoring improving the healthcare in older people who is illiteracy [36].

Understanding patient clinical need: sometimes the patients can attempt to understanding patients and clinical need and the connections between Provider and patient a lot of difficult [36] and difficulty of take Provider medicinal guidance with using a drug or using a healthy lifestyle [37].

Replace traditional: The Telehealth is not replacing the traditional care, sometime it must the patients went to the traditional hospital to take some test of their disease. The patients can visit to reduce the drug, increase it or change it. The most of people used it like the Tele-CDSMP which using with ranching population who limits access to traditional [20]. the different between traditional and telemedicine is very big [26].

Taxonomy Development: Developing the classification based on the specific theme in the previous section. The aim of the classification is to provide the comprehensive reference model and roadmap that help researchers understand the focus of current element. We first extracted 8 positive and 4 negative main research themes. We collect the category related and similar study under one theme, the fig 3 show the taxonomy of the theme in final page.

Future research direction

In the previous system, we provided a systematic review of the research at period 2009 to 2019, and analysis various paper themes related chronic disease. In this section we provide the main limitation of current research and give some useful idea to the future research. We identify this limitation from the depth of the study.

Limitations of Existing Research

There is a growing interest in using mobile technology that help patient of chronic disease to active with the Provider simple and easy. But that does not mean that is not have a limitation below that is the limitation of the Telehealth system or program in chronically disease:

Monitoring: tele monitoring the experience clinical by start apply a new mathematical method to take opportunity [3] some time we can monitoring the chronic conditions may increasingly include the use of implantable devices [31] design future studies of home monitoring should be aware of the risk of increased costs per patient, and special attention of patients [32].

Country which studied: few studied to illness in the low-income countries [35] studied few numbers of patients [5], test the new scales of validity and reliability with patients suffering from chronic disease in Riyadh, Saudi Arabia [39]

Effectiveness: using the effect e-health, Telehealth and PHR, effective online health communities [14]. Providers have more effective and user-friendly information options management

systems. Improvement the new paths of research needed to reach each successive generation of system. focus to detecting deterioration early enough to intervene effectively, another way effective proposition is sharing with design system with experts [36] decision makers in health care search a new interventions leading to better health outcomes with a lower cost, but the cost effectiveness of self-management interventions is still scarce. [33] Policy makers require estimates of comparative effectiveness to applying to the population of interest, but little research on quantitative approaches to assess and extend the generalizability of randomized controlled trial founding[26] we must start by building effective eHealth tools which focus to the consumers with chronic conditions that mean we must now begin to invite the patients into the eHealth development process [24] needed to confirm the cost-effectiveness of e-health interventions for patients with chronic diseases[8].

Improvement: examination source EHR in other settings and compare them directly to understand both the benefits and disadvantages [13]. movement from biomedical and service models of care to user models care which the important patient's telecare systems owes more than social care agencies [16] examined hybrid models like (face-to-face + virtual) may be a worthwhile area of study [18] More optimization, innovation, and high-quality research with using tool of mAdherence has the potential to transform the promise of m-Health technology into the reality of improved healthcare delivery [19].

isolated confounding variables to determine significant relationships between characteristics and cost of RPM program [34]. development a library that implements FHIR, this library is building optimized services in a mobile environment, and converting the process communication between non-standard EMRs without a separate software interface [21]

controlled: should use rigorous approaches to integrate into primary care practices to treat analyses and measure health outcomes in validated, continuous [12]. we can study to help researchers to use the randomized controlled trial to measure clinical outcomes [15]. studies need to establishment the optimal follow-up strategy [6]

Conclusion

The primary objective of our study was to conduct a systematic review of the literature on telehealth of chronic disease and we answer our question RQ1, RQ2 and RQ3. This paper is an example of a using Telehealth with chronic disease of the systematic literature that guides future researchers in that field. We did an objective analysis of the current set of using Telehealth of chronic disease in to positive factor and negative factor. Each of this factor have many themes, the positive factor has 8 themes and negative factor have 4 themes. Also, we have mentioned the restrictions and main gaps in the current research. We think that will help further researches which work in similar filed to start of the gabs. We suggest that more research

need before it is released to the people in general to ensure that is effective in helping the patient. Over the past ten-year good number have been issued. However, if that having the effective and effeteness of that approach.

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Safety 3,4

Reduce hospitalization 3,5,6

High satisfaction using m health 7,8,9,10

Effect the impact on chronic diseases 11,12, 13

Improve heath outcome 8,9,14,15,16,17,18

Enhance self-management 14,19,20,21

Acceptability 9,17,22,23,28,40

Improve quality and effective 5,8,18,21,25,29,38,39

Positive factor

Chronic diseases using telehealth

Cost apply 3,30,32,33,34

Failed to the improve intervention apply 26,35,36
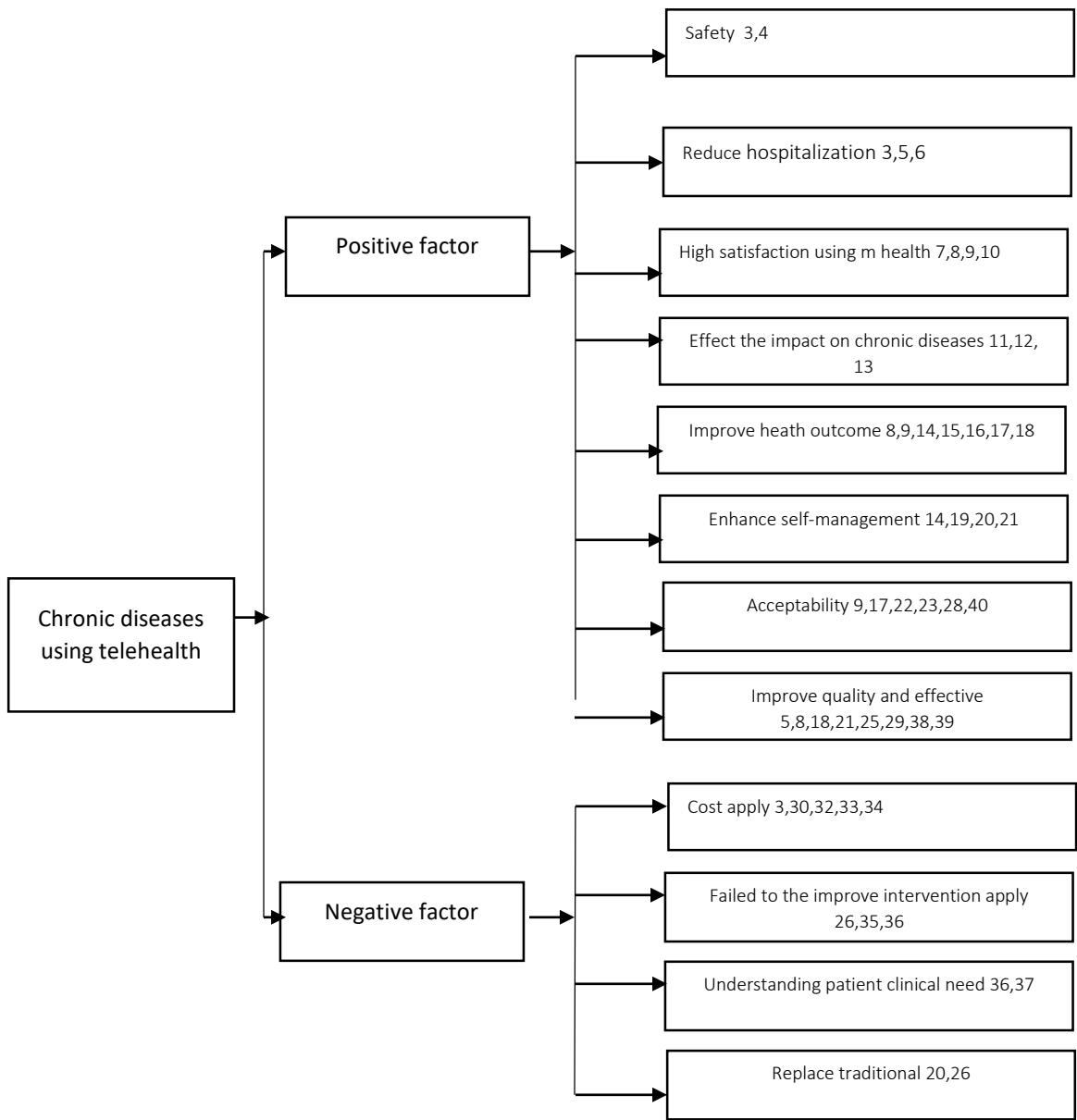
Understanding patient clinical need 36,37

Replace traditional 20,26

Negative factor

Fig.3 taxonomy of the themes