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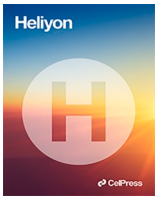

Research article

Factors correlating to decisions for prescribing pharmacological treatment and referrals in suspected peripheral neuropathy cases in chat consultation-based application

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ABSTRACT

Introduction: Since the COVID-19 pandemic, there has been increasing use ofchat-based telemedicine, including for patients with neuropathy complaints. It is imperative to learn how to effectively use telemedicine. This study describes the characteristics of patients with neuropathy complaints in chat-based telemedicine services in Indonesia and their influence on treatment decisions and referrals.

Methods: This is a retrospective cross-sectional study during the COVID-19 pandemic era (March 2020 to December 2021) using anonymous secondary data from patient chat databases on Indonesian application-based telemedicine services (Halodoc, Alodokter, Good Doctor, and Milvik). We applied bivariate and multivariate analysis.

Results: We obtained 1051 patients with suspected peripheral nerve complaints (4 per 10,000) from a total of 2,199,527 user consultations, with the majority being 40–64 years old females and diabetes mellitus was the leading comorbid (90.7%). Most patients received treatment (90.7%) and only 11.4% patients were referred. Multivariate analysis showed that treatment was more likely to be given by a neurologist ($p < 0.01$). Chronic symptoms ($p < 0.01$) and previous laboratory/other tests ($p = 0.01$) decreased the likelihood of medication prescription. Referrals were more likely to be given to chronic onset ($p = 0.02$), hypertension and heart disease ($p < 0.01$), and previous laboratory/other tests ($p = 0.02$). The opposite was true for age≥65 years, female ($p = 0.04$), and neurologists or other specialists as responders ($p < 0.01$).

Conclusion: We identified several factors that influence the treatment decision such as female patients and onset. Meanwhile, age, sex, chronic symptoms, history of hypertension and heart disease, and previous laboratory/other tests may influence the referral decisions. General practitioners were more likely to refer the patients whereas neurologists or other specialists were more likely to give treatment. Chat-based telemedicine services can still be developed in the future to be better.

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1. Introduction

Peripheral neuropathy is one of the most common neurological disorders in adults in Indonesia [1]. Approximately 2.4% of the world's population has peripheral neuropathy and the prevalence increases to 8% with age. Peripheral neuropathy is caused by various etiologies, such as diabetes, vascular condition, and even from infection. These patients require strict follow up in order to prevent their disease progression. Oftentimes, patients suffering from peripheral neuropathy with debilitating underlying diseases prefer electronic consultation for convenience. The option of teleconsultation offers them a medical consultation bypassing distance yet with similar costs as in-patient consultation [2–4].

The rapid development of the use of teleconsultation is seen in recent years especially during the pandemic. This has benefitted patients in rural areas and with disabilities, including patients with complaints of peripheral neuropathy. However, to date, there have been no studies examining the nature of doctors' diagnostic, referral, and treatment decisions made from patients' history taking taken through teleconsultation in Indonesia. Therefore, this study was conducted.

2. Literature review

Telehealth is defined as the usage of medical information through electronic communication to improve a patient's health [5]. This term has been interchangeably used with telemedicine, which is defined by the National Institutes of Health as providing support and healthcare when distance hinders the participants through the use of electronic communication and information technologies [6]. While telemedicine is a subset of telehealth, telemedicine focuses more on the clinical service provided [7]. It was originally developed to provide care to patients in rural areas and underserved patients [6,7]. Telehealth and telemedicine have created a heated debate worldwide for more than a decade, yet they surge to prosper especially during the recent pandemic in 2019. One form of telemedicine that has bloomed into worldwide phenomenon is teleconsultation. Using teleconsultation, patients can easily consult any health professionals of their choosing without worrying about the distance or time. Not only patients, but health professionals can easily consult other professionals with ease [8]. For patients in rural areas and/or with disabilities, telehealth has saved them from the trouble of face-to-face consultation with similar cost and services [9].

Peripheral neuropathy is not a diagnosis, but it is a symptom with varying etiologies, ranging from vitamin deficiency to auto-immune diseases (e.g. Guillain-Barre syndrome) with various manifestations and complications. Some of these etiologies are the world's non-communicable diseases burdens which could be prevented early on, such as diabetes and vascular diseases. According to the affected peripheral nervous system, peripheral neuropathy varies into sensory, motor or autonomic symptoms. As it is one of the most commonly seen symptoms in medical practice, an in-depth examination to find the underlying etiology is needed. Hence why the diagnosis and treatment of peripheral neuropathy relies heavily on the historical examination [2–4,10]. [2–4,10] [2–4,10] [[,10] Unfortunately, due to the scarcity of neurologists in rural areas, also due to transportation and geographical barriers, it's almost impossible to always have in-person neurological consultation [11,12]. Therefore, there has been an increasing number of electronically designed neurology clinics, called teleneurology, to solve this problem.

Teleneurology focuses on neurological complaints and uses remote audio and/or visual communication [13]. A pilot study conducting a tele-polyneuropathy clinic in Los Angeles concluded an average patient-satisfaction score of 8.9. From the same study, 75% of the patients had strong preferences for the tele-polyneuropathy clinic compared to in-person care for follow up [14]. Therefore, a good teleconsultation service for complaints of neuropathy symptoms can assist in the management and early detection of complications of chronic diseases. This is certainly beneficial in effectively shortening the time it needs to follow-up patient treatment [15].

Despite its benefits in overcoming distance and geographical problems, teleconsultation still has its drawbacks. One of the drawbacks is that most often than not, we can only rely on the patient's historical examination for diagnosing and deciding treatment without real-time physical examination [8,15,16].

3. Methods

This study is a retrospective cross-sectional study from secondary data gained from the Indonesian chat-based telemedicine service (Halodoc, Alodokter, Good Doctor, and Milvik). Anonymous data were taken by total sampling from March 2020 to December 2021.

The inclusion criteria were peripheral neuropathy symptoms complained by patients or their families submitted via chat-based telemedicine and complainants must be 18 years old or older. We excluded patients with incomplete demographic data (age or name) and we also excluded chats that were interrupted in the middle of the conversation.

3.1. Data retrieval

Secondary data was retrieved through a search on the chat database of each application provider. Researchers used the keywords: neuropathy, tingling, neuropathic pain, numbness, muscle weakness, and reduced sweating. We examined the filtered chat conversations.

The variables studied wereage (<40 years old, 40–64 years old, ≥65 years), sex (male or female), previous diagnosis related to neuropathy symptoms (yes or no), complainants (patients themselves or families), responder (general practitioner, neurologist, other specialists), onset of symptoms (acute less than 4 weeks, subacute 4 weeks–12 weeks, and chronic more than 12 weeks [14]), comorbidities (diabetes mellitus, hypertension, dyslipidemia, impaired liver, thyroid, and kidney function, and obesity), the patient's

neuropathy complaints (neuropathic pain/paresthesia, hypoesthesia, muscle cramps/weakness, and hypohidrosis), and history of laboratory or other additional tests (yes or no).

The dependent variable in this study was the pharmacological treatment decisions and referral decisions. In addition, referrals mentioned in this study refer to physicians giving patients the option to consult further through face-to-face consultations or to other offline health services. Self–referral, which is defined as the patient choosing the option to meet face–to–face with the respondent, is included in the referral analysis. Pharmacological treatment includes every drug treatment prescribed, be it for symptomatic or definitive treatment for neuropathy symptoms. We group the specialists into neurologists and non–neurology specialists, both hospital-based specialists and non-hospital-based specialists that patients interacted with.

3.2. Data analysis

Researchers used IBM Statistical SPSS Version 20 to analyze the data. Univariate and bivariate analysis were performed. also calculated the effect estimate with odds ratio (OR) and 95% confidence interval followed by multivariate analysis using logistic regression. Logistic regression analysis will only include variables that have a p-value of <0.25 from the previous bivariate analysis. The usage of p-value of <0.25 is as recommended by Hosmer et al. for initial variable selection using regression analysis [17]. At the end of the analysis, to cross check, researchers entered variables that did not initially pass the selection to see whether there was an effect on the multivariate model. The p-value considered significant in this study's statistical analysis is $p < 0.05$.

4. Result

4.1. Demographic data

Out of the 2,199,527 patients that complained of neuropathy symptoms via telemedicine chat services, 1051 patients fulfilled the inclusion and exclusion criteria. Table 1 showed the characteristics of the patients in this study. The mean age of patients was 42.8 (age range 13–93) years old and most patients included in this study were female (66.1%). There were 11.2% of patients who already had a previous neuropathy diagnosis. Most of the complaints were made by the patient themselves (75%) instead of by their families. Researchers also analyzed the respondents of these complaints. Most of the consultations were answered by neurologists (63%) followed by general practitioners (25.8%). Out of all the peripheral neuropathy complaints, diabetes mellitus came up as the most common comorbidity.

Most patients that consulted on chat-based telemedicine services in this study received treatment (90.7%). However, only a small percentage (11.4%) of patients received referrals as seen in Table 2.

Bivariate analysis of treatment decisions showed statistically significant differences in some of the characteristics as shown in

Table 1
Patient characteristics.

Patient Characteristic		N	%
Age	<40 years	472	44.9
	40–64 years	498	47.4
	≥65 years	81	7.7
Sex	Male	356	33.9
	Female	695	66.1
Complainant	Patient themselves	788	75
	Caregivers	263	25
Previous neuropathy diagnosis	Yes	118	11.2
	No	933	88.8
Responder	General Practitioner	271	25.8
	Neurologist	662	63
	Other Specialist	118	11.2
Symptoms Onset	Acute (<4 weeks)	683	65
	Subacute (4 weeks to <12 weeks)	135	12.8
	Chronic (>12 weeks)	233	22.2
History of Telemedicine Usage	New User	1028	97.7
	Old User	23	2.2
Comorbidity	Diabetes Mellitus	953	90.7
	Dyslipidemia	91	8.7
	Hypertension and Heart Disease	132	12.6
	Obesity	33	3.1
	Others	16	1.5
Symptoms	Numbness, Tingling, Shooting. Burning, Electric shock, Painful Cold, Paresthesia	913	86.9
	Hypoesthesia	247	23.5
	Muscle cramps/weakness	166	15.8
	Hypohydrosis	19	1.8
History of Laboratory or other additional tests	Yes	121	11.5
	No	930	88.5

Table 3. Female patients were more likely to get pharmacological treatment than males (OR = 1.75; 95%CI 1.14–2.45; p = 0.01). Pharmacological treatments were given to almost all groups of ages equally. The majority of respondents of complaints giving pharmacological treatment as neurologists was also shown to be statistically significant with $p < 0.01$ compared to general practitioners and other specialists. Statistical differences between onset of symptoms (acute, sub-acute, and chronic) were found to be significant with p = 0.03. The only symptom found to be statistically significant was hypoesthesia (OR = 2.60; 95%CI 1.37–4.96; $p < 0.01$). Whether patients had previous testing or not proved to be significant in determining treatment (OR = 0.50; 95%CI 0.29–0.86; p = 0.01). Complaints made by the patient themselves, previous diagnosis of neuropathy, and new or old telemedicine usage were found to be not statistically significant.

Further analysis found no statistically significant differences between all age groups as shown in Table 4. Whether a patient had an acute or chronic onset was found to be a statistically significant determinant for treatment or referral outcome with an OR = 0.55 (95% CI: 0.35–0.88; p = 0.01). Neurologists gave pharmacological treatment significantly more compared to general practitioners (OR = 11.97; 95%CI 6.86–20.88; $p < 0.01$) or other specialists (OR = 0.17; 95% CI 0.08–0.34) while general practitioners significantly gave less pharmacological treatment compared to other specialists (OR = 2.01; 95%CI 1.11–3.65; p = 0.02).

4.2. Analysis of Patient Characteristics to referral decision

Table 5 shows some statistically significant differences that contribute to referral decisions in this study. The respondents and time of complaint showed significant differences in referral decision with each having $p < 0.01$ and p = 0.04. Analysis between groups of responders showed a significant difference between neurologists vs. other specialists (OR = 3.07; 95%CI 1.70–5.52; $p < 0,01$) and between general practitioners vs. neurologists with OR = 0.2 (95%CI 0.13–0.304; $p < 0,01$). Analysis between time of complaints groups showed a significant difference in the acute vs chronic group with OR = 1.73 (95%CI 1.13–2.66; p = 0.01) as shown in Table 6. Significant differences were also found between both sexes with OR = 0.572 (95%CI 0.391–0.836; p = <0.01) and history of laboratory or other additional tests with OR = 1.705 (95%CI 1.020–2.85; p = 0.040). Regarding comorbidities, statistically significant differences were found in diabetes mellitus (OR = 1.57; 95%CI 1.04–2.36; p = 0.03), dyslipidemia (OR = 1.851; 95%CI 1.053–3.255; p = 0.030), hypertension (OR = 2.08; 95%CI 1.29–3.35; $p < 0.01$), and obesity (OR = 2.513; 95%CI 1.107–5.702; p = 0.05).

4.3. Multivariate analysis

Multivariate analysis was carried out on pharmacological treatment decisions as seen in Table 7. Pharmacological treatments were more likely to be given by neurologists or other specialists as responders ($p < 0.01$). Treatment decisions were also significantly less likely to be given if patients had chronic symptoms ($p < 0.01$), and if there were previous laboratory/other supporting tests ($p < 0.01$).

Multivariate analysis was also carried out on the referral decisions made which can be seen in Table 8. Referrals were more likely to be given to patients with chronic onset (p = 0.02), Hypertension and Heart Disease ($p < 0.01$), and to patients with previous laboratory/other supporting tests (p = 0.02). However, referrals were significantly not given to patients with age ≥65 years (p = 0.04), female (p = 0.04), and if the responders were neurologists ($p < 0.01$) or other specialists (p = 0.03).

5. Discussion

In this study, there were 1051 consultation data with neuropathy complaints included in the study from a total of approximately 2,199,527 user consultations. Therefore, we can easily count the prevalence of neuropathy symptoms during the period of the study as 4 cases per 10,000 patients or 0.4%. This prevalence is lesser than other population-based epidemiological studies of neuropathy with an incidence of 77 cases per 100,000 persons per year and has a prevalence of around 1–12% in all age groups [10,18,19]. The low proportion of patients that consulted with neuropathy complaints via chat-based services does not represent the overall population. Moreover, the COVID-19 pandemic might play a role in the low proportion of patients as respiratory or other complaints took more priority. The other possibility for this low prevalence is the lack of access to technology and the general lack of urgency to complain about neuropathy symptoms [20].

As seen in Table 1, neuropathy complaints were mostly made in the age group of 40–64 years old. This is slightly different from a research conducted in Romania which found that the higher the age, the higher the risk of experiencing neuropathy [21]. However elderly patients tend to be less technology savvy compared to their younger peers and so this might be the determining factors that contribute to the lower proportion of complaints from the elderly group in this study [22].

In this study, females (66.1%) were more likely to use telemedicine to complain about peripheral neuropathy symptoms compared

Table 2
Patient consultations outcome.

Consultations Outcome		n	%
Pharmacological Treatment	No	98	9.3
	Yes	953	90.7
Referral Decision	No	928	88.3
	Yes	123	11.7

Analysis of Patient Characteristics on Treatment Decision.

Table 3
Bivariate analysis of patient characteristics on treatment decision.

Patient Characteristics		Pharmacological Treatment		*p*	OR (95% CI)
		No n (%)	Yes n (%)		
Age	<40 years	46 (9.7)	426 (90.3)	0.91	NA
	40–64 years	45 (9)	453 (91)		
	≥65 years	7 (8.6)	74 (91.4)		
Sex	Male	45 (12.6)	311 (87.4)	0.01	1.75 (1.14–2.45)
	Female	53 (7.6)	642 (92.4)		
Complainant	Patient themselves	74 (9.4)	714 (90.6)	0.9	1.03 (0.64–1.67)
	Caregivers	24 (9.1)	239 (90.9)		
Previous neuropathy diagnosis	Yes	13 (11)	105 (89)	0.50	1.24
	No	85 (9.1)	848 (90.9)		(0.67–2.29)
Responder	General Practitioner	65 (24)	206 (76)	<0.01	NA
	Neurologist	17 (2.6)	645 (97.4)		
	Other Specialist	16 (13.6)	102 (86.4)		
Onset	Acute	55 (8.1)	628 (91.9)	0.03	NA
	Subacute	11 (8.1)	124 (91.9)		
	Chronic	32 (13.7)	201 (86.3)		
Telemedicine Usage	New Users	95 (9.2)	933 (90.8)	0.47	1.47 (0.43–5.05)
	Old Users	3 (13)	20 (87)		
Comorbidity	Diabetes Mellitus	29 (11.6)	222 (88.4)	0.16	0.72 (0.46–1.14)
	Dyslipidemia	12 (13.2)	79 (86.8)	0.18	0.65 (0.34–1.24)
	Hypertension and Heart Disease	17 (12.9)	115 (87.1)	0.13	0.65 (0.37–1.14)
	Others	3 (18.8)	13 (81.3)	0.18	0.44 (0.12–1.56)
	Obesity	6 (18.2)	27 (81.8)	0.12	0.45 (0.18–1.11)
Symptoms	Numbness, Tingling, Shooting. Burning, Electric shock, Painful Cold and/or Paresthesia	86 (9.4)	827 (90.6)	0.79	0.92 (0.49–1.72)
	Hypoesthesia	11 (4.5)	236 (95.5)	<0.01	2.60 (1.37–4.96)
	Muscle weakness	13 (7.8)	153 (92.2)	0.47	1.25 (0.68–2.30)
	Hypohydrosis	3 (15.8)	16 (84.2)	0.41	0.54 (0.16–1.89)
Previous of Laboratory/other test	Yes	19 (15.7)	102 (84.3)	0.01	0.50 (0.29–0.86)
	No	79 (8.5)	851 (91.5)		

to their male peers. Several previous community and hospital-based studies have also reported similar results. Abraham reported that neuropathic pain complaints were more intense in females with diabetes regardless of the diagnosis status of polyneuropathy. Therefore females are said to be more sensitive to sensory disturbances [23]. Various studies have also found the correlation between menopause and nerve conduction velocity with the reduced level of estrogen as the main factor developing peripheral neuropathy [24, 25]. The predominance of females in using teleconsultation was also found in a study by Edwards et al. [26] with females being almost twice as likely to have teleconsultation compared to males. Sex differences in the incidence of peripheral neuropathy have also been reported with mixed results across studies. Variations depend on the etiology of the peripheral neuropathy as well as the specific population studied in each study [23,25].

Most of the patient's complaints were submitted by the patients themselves (75%) instead of a family member. This corresponds with the finding that most patients were in the 40–64 years old group, which is likely to be more savant in technology compared to their older peers. As previous study has concluded that the younger the patient is, the more prepared they will be in using telemedicine

Table 4
Bivariate analysis between groups patient age, respondent, and symptoms onset on treatment decision. GP = general practitioner.

Patient Characteristics	Pharmacological Treatment		P value	Odds Ratio (95% CI)
	No n (%)	Yes n (%)		
Patient Age				
40–64 years old	45 (9)	453 (91)	0.91	1.05 (0.46–2.42)
≥65 years old	7 (8.6)	74 (91.4)		
<40 years old	46 (9.7)	426 (90.3)	0.71	1.09 (0.71–1.67)
40–64 years old	45 (9)	453 (91)		
<40 years old	46 (9.7)	426 (90.3)	0.76	1.14 (0.50–2.63)
≥65 years old	7 (8.6)	74 (91.4)		
Responder				
Neurologist	17 (2.6)	645 (97.4)	<0.01[a]	0.17 (0.08–0.34)
Other Specialist	16 (13.5)	102 (86.5)		
GP	65 (24)	206 (76)	<0.01	11.97 (6.86–20.88)
Neurologist	17 (2.6)	645 (97.4)		
GP	65 (24)	206 (76)	0.02	2.01 (1.11–3.65)
Other Specialist	16 (13.5)	102 (86.5)		
Onset				
Subacute	11 (8.1)	124 (91.9)	0.11	0.557 (0.27–1.15)
Chronic	32 (13.7)	201 (86.3)		
Acute	55 (8.1)	628 (91.9)	0.97	0.987 (0.50–1.94)
Subacute	11 (8.1)	124 (91.9)		
Acute	55 (8.1)	628 (91.9)	0.01	0.55 (0.35–0.87)
Chronic	32 (13.7)	201 (86.3)		

[a] Fisher's Test.

services [22]. Another study identified the difficulties older group patients have when using telemedicine which is the lack of ability to use electronic devices and internet usage. Out of 30 subjects, only 7 had had telemedicine consultation despite reported having electronic access. They suggested that extensive doctor-patient communication is needed to overcome this hurdle [27].

About 63% of complaints were answered by neurologists as seen in Table 1. This can partially indicate that most patients seeking telemedicine consultations are already prepared to choose a specialist before their consultation. Most of the patients (65%) complained of acute onset neuropathy (<4 weeks). The sooner the complaint is submitted, the faster the patient can get the treatment they need.

Almost all patients were new users of telemedicine services (97.7 %) compared to long-time users. This shows that most patients only complained about new symptoms and not recurrent symptoms, which indicates patients' follow-up through chat-based telemedicine is still severely lacking. Research has shown that there are only slight differences in follow-up rates between users of telemedicine and face-to-face consultations. Kumar's research explains that good communication between doctors and patients will help increase patients' satisfaction with health services and increase follow-up of telemedicine services [28]. In addition, the patients' motives for using teleconsultation are also varied and patients' preference might influence the treatment regime [29–31].

Most of the patients in this study had diabetes mellitus (DM) as comorbid (90.7%). The pathophysiology between diabetes mellitus and neuropathy is not fully understood. The current understanding is that hyperglycemia leads to nerve cell damage [32–35]. Other comorbidities seen in patients with peripheral neuropathy are hypertension and dyslipidemia. Similar with hyperglycemia, dyslipidemia and hypertension causes microvascular disorder due to chronic endothelial injury and dysfunction which results in nerve damage [36–39].

Most of the neuropathy symptoms were positive sensory complaints in the form of numbness, tingling, shooting, burning, electric shock, painful cold, and paresthesia (86.9%) followed by hypoesthesia (23.5%) then muscle weakness (15.8%). This finding is supported by previous literature which stated that the most commonly found symptoms of peripheral neuropathy were numbness and paresthesias; pain, weakness, and loss of deep tendon reflexes may accompany these symptoms.3 The patients who consulted on telemedical services mostly had never had a laboratory or other supporting examinations related to their medical condition. This is certainly unfortunate considering that supporting investigations are an important component in the path of diagnosing neuropathy complaints and ruling out differential diagnosis [40].

Most of the patients in our study received pharmacological therapy (90.7%) yet the nature of the therapies given is very diverse and varies between doctors. Our analysis showed that many factors statistically significantly influence caregivers' decisions on treatment when viewed with the bivariate model as shown in Tables 3 and 4. Despite pharmacological treatments being given to each age group equally, doctors gave pharmacological treatment to female patients more compared to their male peers (OR = 1.75; 95% CI 1.14–2.45; p = 0.01). This might be due to the fact that females are more likely to experience and/or complain more about peripheral neuropathy symptoms, as well as reportedly using telemedicine consultation services more than males as has been discussed before [23–26].

Respondents as neurologists and other specialists give pharmacological treatment statistically significantly more compared to general practitioners ($p < 0.01$ and $p = 0.02$) as seen in Tables 3 and 4. This is probably due to many neurological symptoms needing more specialized skill sets than general practitioner level. In Indonesia, where the study is being conducted, neuropathic pain and neuropathy are considered level 3 A, which means general practitioners need to be able to identify and give early treatment but must refer to specialists for further treatment [41]. The primary diagnostic tools for neuropathy are nerve conduction studies and electromyography (NCS/EMG) which requires a more specialist qualifications [42]. Hence why many general practitioners (24%) prefer to

Table 5
Bivariate analysis of patient characteristics on referral decision.

Patient Characteristic		Referral Decision		*p*	OR (95% CI)
		No n (%)	Yes n (%)		
Age	<40 years	415 (87.9)	57 (12.1)	0.27	NA
	40–64 years	437 (87.8)	61 (12.2)		
	≥65 years	76 (93.8)	5 (6.2)		
Sex	Male	300 (84.3)	56 (15.7)	<0.01	0.57 (0.39–0.84)
	Female	628 (90.4)	67 (9.6)		
Complainant	Patient themselves	695 (88.2)	93 (11.8)	0.86	0.96 (0.62–1.49)
	Caregivers	233 (88.6)	30 (11.4)		
Previous neuropathy diagnosis	Yes	101 (85.6)	17 (14.4)	0.33	0.76 (0.44–1.32)
	No	827 (88.6)	106 (11.4)		
Responder	GP	206 (76)	65 (24)	<0.01	NA
	Neurologist	623 (94.1)	39 (5.9)		
	Other Specialist	99 (83.9)	19 (16.1)		
Onset	Acute (<4 weeks)	614 (89.9)	69 (10.1)	0.04	NA
	Subacute (4 weeks to <12 weeks)	119 (83.7)	16 (16.3)		
	Chronic (>12 weeks)	195 (83.7)	38 (16.3)		
History of Telemedicine Usage	New Users	907 (88.2)	121 (11.8)	1	1.40 (0.32–6.048)
	Old Users	21 (91.3)	2 (8.7)		
Comorbidity	Diabetes Mellitus	212 (84.5)	39 (15.5)	0.03	1.57 (1.04–2.36)
	Dyslipidemia	74 (81.3)	17 (18.7)	0.03	1.851 (1.05–3.25)
	Hypertension and Heart Disease	106 (80.3)	26 (19.7)	<0.01	2.08 (1.29–3.35)
	Others	12 (75)	4 (25)	0.11	2.57 (0.81–8.08)
	Obesity	25 (75.8)	8 (24.2)	0.05	2.51 (1.11–5.70)
Symptoms	Numbness, Tingling, Shooting. Burning, Electric shock, Painful Cold and/or Paresthesia	804 (88.1)	109 (11.9)	0.54	1.20 (0.67–2.16)
	Hypoesthesia	221 (89.5)	26 (10.5)	0.51	0.86 (0.54–1.36)
	Muscle weakness	148 (89.2)	18 (10.8)	0.71	0.90 (0.53–1.53)
	Hypohydrosis	15 (78.9)	4 (21.1)	0.27	2.05 (0.67–6.27)
History of Laboratory or other additional test	Yes	100 (82.6)	21 (17.4)	0.040	1.705 (1.02–2.85)
	No	828 (89)	102 (11)		

refer the patients as seen in Table 5.

The decision to treat was also found to be significantly affected by whether the symptom was acute, sub-acute, or chronic. Acute symptoms are significantly more likely to be treated compared to chronic symptoms OR = 0.55 (95%CI: 0.35–0.88; p = 0.01) as described in Table 4. This aligns with the level of competency of Indonesian general practitioners according to the local consensus for standard level of competency [41]. Another factor which influences pharmacological treatment decision is if the patients had had laboratory and or other supportive findings (OR = 0.50; 95%CI 0.29–0.86; p = 0.01) as shown in Tables 3 and 4. Supportive findings from diagnostic tools such as NCS/EMG effectively narrows the various differential diagnosis for peripheral neuropathy and can increase the success in finding the right etiology and hence the right treatment regime [42].

If we look at the multivariate model on treatment on Table 7, we can find that the responder, the onset of symptoms, and the history of laboratory or other supporting examinations are independent factors that influence the provision of pharmacological treatment. It is seen that patients consulted by neurologists are significantly more likely to be given pharmacological therapy compared to patients

Table 6
Bivariate analysis between groups patient age, respondent, and symptoms onset on referral decision.

Patient Characteristics	Referral Decision		p	Odds Ratio (95% CI)
	No n (%)	Yes n (%)		
40–64 years old	437 (87.6)	61 (12.4)	0.11	0.471 (0.18–1.21)
≥65 years old	76 (93.8)	5 (6.2)		
<40 years old	415 (87.9)	57 (12.1)	0.93	1.016 (0.69–1.49)
40–64 years old	437 (87.6)	61 (12.4)		
<40 years old	415 (87.9)	57 (12.1)	0.12	0.48 (0.19–1.23)
≥65 years old	76 (93.8)	5 (6.2)		
Responder				
Neurologist	623 (94.1)	39 (5.9)	<0.01	3.07 (1.70–5.52)
Other Specialist	99 (83.9)	19 (16,1)		
General Practitioner	206 (76)	65 (24)	<0.01	0,20 (0.13–0.30)
Neurologist	623 (94.1)	39 (5.9)		
General Practitioner	206 (76)	65 (24)	0.08	0.61 (0.35–1.07)
Other Specialist	99 (83.9)	19 (16.1)		
Symptoms Onset				
Subacute	119 (88.1)	16 (11.9)	0.24	1.45 (0.77–2.71)
Chronic	195 (83.7)	38 (16.3)		
Acute	614 (89.9)	69 (10.1)	0.54	1.20 (0.67–2.13)
Subacute	119 (88.1)	16 (11.9)		
Acute	614 (89.9)	69 (10.1)	0.01	1.73 (1.13–2.66)
Chronic	195 (83.7)	38 (16.3)		

Table 7
Multivariate analysis on pharmacological treatment decision.

Variable	B	SE	*P Value*	Adjusted OR	CI 95%
Responder					
General Practitioner	Ref				
Neurologist	2.57	0.29	<0.01	13.08	7.39–23.16
Other Specialist	0.86	0.32	<0.01	2.37	1.26–4.44
Onset					
Acute	Ref				
Subacute	−0.07	0.37	0.84	0.93	0.45–1.93
Chronic	−0.72	0.26	<0.01	0.48	0.29–0.80
History of lab/other test					
No	Ref				
Yes	−0.85	0.31	<0.01	0.43	0.23–0.78
Other Comorbidity					
No	Ref				
Yes	−1.14	0.71	0.10	0.32	0.08–1.28
Sex					
Male	Ref				
Female	0.42	0.23	0.07	1.51	0.96–2.38
Hypertension and Heart Disease					
No	Ref				
Yes	−0.58	0.22	0.06	0.56	0.30–1.03

consulted by general practitioners ($p < 0.01$). This aligns with results from the bivariate models (Tables 3 and 4) and has been discussed, general practitioners likely see neuropathies as above their competency levels. Symptomatic therapies can be given to overcome acute symptoms according to the local standard of competency of GP, but definitive therapy related to the etiology also needs to be done in order to prevent recurrent neuropathy. As it stands, definitive diagnosis and therapies of neuropathies are more likely done by neurologists or other specialists [41,42]. Ultimately, if patients had chronic symptoms ($p < 0.01$) and a history of supporting examinations ($p \leq 0.01$) respondents were significantly more likely not to give pharmacological therapy but immediately refer the patient. As has been mentioned, the most common comorbidity of neuropathy is diabetes mellitus, followed by hypertension and heart disease, and dyslipidemia. These chronic non-communicating diseases often need comprehensive management by specialists when neuropathy is already involved. Especially in patients whose metabolic status is known, it is logical for general practitioners to refer the patients immediately [43].

Most of the patients were not referred (88.3%) in this study as seen in Tables 5 and 6. This may be because most patients were treated directly by neurologists with the right level of skills and knowledge in diagnosing and giving therapy according to the most recent evidence-based medicine [44]. However, it is notable to mention that during the study there was limited possibility for the patients to be referred to hospitals during the COVID-19 pandemic. In the multivariate model on referral decisions shown on Table 8, the age ≥65 years old, sex, the responder, chronic symptoms, history of hypertension, and history of laboratory/other supporting

Table 8
Multivariate analysis on referral decision.

Variabel	B	SE	*P Value*	Adjusted OR	CI 95%
Age					
<40 years	Ref				
40–64 years	−0.41	0.23	0.07	0.66	0.42–1.04
≥65 years	−1.07	0.54	0.04	0.34	0.13–0.94
Sex					
Male	Ref				
Female	−04.3	0.21	0.04	0.65	0.43–0.97
Responder					
General Practitioner	Ref				
Neurologist	−1.68	0.23	<0.01	0.18	0.13–0.29
Other Specialist	−0.68	0.31	0.03	0.51	0.28–0.93
Symptoms Onset					
Acute	Ref				
Subacute	0.23	0.32	0.46	1.26	0.68–2.34
Chronic	0.58	0.24	0.02	1.78	1.11–2.85
DM					
No	Ref				
Yes	0.24	0.25	0.33	1.27	0.78–2.06
Hypertension and Heart Disease					
No	Ref				
Yes	1.03	0.27	<0.01	2.79	1.64–4.76
Previous laboratory/other test					
No	Ref				
Yes	0.69	0.286	0.02	1.99	1.13–3.48
Previous neuropathy diagnosis					
No	Ref				
Yes	0.42	0.31	0.18	1.51	0.82–2.79

examinations were independent factors that significantly influence referral decisions. Old age (≥65 years) was less likely to be referred to compared to the younger patients (under 40 years of age). Although again, this might be due to elderly patients being less inclined to go to hospitals because of higher risks of COVID–19 exposure, despite the benefit of referral in having a more accurate diagnosis and ruling out the differential diagnosis [37,40,45,46]. Despite having more female patients in this study, females were found to have fewer referral numbers as seen in Table 8. The subjective preference of female patients for not being referred during COVID-19 pandemic circumstances might be a contributor to this phenomenon.

Chronic symptoms compared to acute symptoms, the presence of hypertension, and a history of laboratory or other supporting tests were factors that might influence the referral decisions as shown in Table 5, Table 6, and Table 8. Younger patients are more likely to be referred to compared to elderly patients as seen on Tables 6 and 8. This may be because it is not common for younger patients to experience peripheral neuropathy and when they do experience the symptom, it is usually due to special causes such as autoimmune diseases and/or genetics [10]. Therefore, in younger patients with complaints of neuropathy, referrals need to be made to confirm the diagnosis.

We found that chat-based telemedicine services in Indonesia have not integrated the use of simple tools that might help assess neuropathy complaints in an objective matter such as Subjective Peripheral Neuropathy Screen Questionnaire (SPNSQ) (Cronbach's alpha = 0.86) by MacArthur [47], Neuropathy Symptom Score [48], Neuropathy Total Symptom Score–6,[49] or even the most basic Visual Analogue Scale or Numerical Rating Scale to assess the severity of the pain that can lead doctors to have different clinical judgments. A pilot study has also shown that neuropathy scoring can be used in a telemedicine setting [50–52]. In addition, Wilson's research attempted to develop clinical teleneurology for patients with polyneuropathy. The study found that the use of teleneurology with a video teleconference clinic platform has an efficiency equivalent to face-to-face services. However, it is still limited in terms of treatment options and physical examination [52].

5.1. Limitations, scope of work, and future suggestions

This is the first study attempting to describe neuropathy complaints from Indonesian telemedicine services based on user chat data, so there is limited literature that can be taken and reviewed. On top of that, the cross-sectional study method cannot assess the causal relationship between factors in the study. There are also no standard guidelines and questionnaires to conclude diagnosis and provide management decisions in the chat-based telemedicine services. Moreover, the laboratory tests data and the prescribed medicine data used in this study unfortunately have not been analyzed according to their relevance to the peripheral neuropathy complaints due to limited access given from the applications providers. Another important thing to consider is that the diagnosis used in this study cannot be established according to proper state-of-the-art standards due to the limited interaction between patients and physicians, causing physicians unable to perform the standardized health examination.

This research is expected to help provide an overview of the decision to refer and provide treatment for patients with complaints of neuropathy who conduct chat-based telemedicine consultations. The data from this study can aid chat-based telemedicine services to

develop their applications better in the future. The data obtained can also be used to create standardized protocol for chat-based teleneurology consultations in order to allow standardized state-of-the-art consultations, diagnosis, and proper management through chat-based services.

6. Conclusion

In this study, sensitive complaints were submitted mainly by patients themselves with most of them being female in the age group of 40–64 years old. Most of the patients had previously been diagnosed with neuropathy and the most common comorbid was diabetes. The most responders were neurologists. Several factors were identified that influence the decision to give pharmacological treatment such as female patient, neurologist as the responder, acute symptom onset, and hypoesthesia complaints. Meanwhile, age, sex, general practitioner as the responder, chronic symptom onset, comorbidities (DM, dyslipidemia, hypertension, and obesity), and history of laboratory/other supporting tests influence referral decisions. Further research and specific telemedicine-based guidelines were required to improve the standard of care for patients with neuropathy complaints.

Ethical declaration

This research has received approval from the Ethics Committee of the Faculty of Medicine, University of Indonesia with letter number: KET-669/UN·2F1/ETIK/PPM.February 00, 2021 on February 2021 and was conducted in accordance with the Helsinki Declaration. Researchers also did not involve patients directly and data analysis was done strictly from medical records obtained from chat databases, therefore consent was waivered by the Ethics Committee of the Faculty of Medicine, University of Indonesia with the same letter number.

Data availability

Question	Response
Data Availability Sharing research data helps other researchers evaluate your findings, build on your work and to increase trust in your article. We encourage all our authors to make as much of their data publicly available as reasonably possible. Please note that your response to the following questions regarding the public data availability and the reasons for potentially not making data available will be available alongside your article upon publication. Has data associated with your study been deposited into a publicly available repository?	No
Please select why. Please note that this statement will be available alongside your article upon publication. as follow-up to "**Data Availability** Sharing research data helps other researchers evaluate your findings, build on your work and to increase trust in your article. We encourage all our authors to make as much of their data publicly available as reasonably possible. Please note that your response to the following questions regarding the public data availability and the reasons for potentially not making data available will be available alongside your article upon publication. Has data associated with your study been deposited into a publicly available repository? "	The data that has been used is confidential

CRediT authorship contribution statement

Pukovisa Prawiroharjo: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Hikma Anggraini:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Iskandar Purba Geraldi:** Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Fitri Octaviana:** Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Astri Budikayanti:** Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Ahmad Yanuar Safri:** Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Winnugroho Wiratman:** Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Luh Ari Indrawati:** Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Nurul Fadli:** Writing – original draft, Validation, Supervision, Project administration, Methodology, Data curation, Conceptualization. **Adrian Ridski Harsono:** Writing – original draft, Validation, Supervision, Project administration, Methodology, Data curation, Conceptualization. **Manfaluthy Hakim:** Writing – original draft, Validation, Supervision, Project administration, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] M. Hakim, K. N, P. R, T. D, B. M, H. H, et al., A review on prevalence and causes of peripheral neuropathy and treatment of different etiologic Subgroups with Neurotropic B vitamins, J Clin Exp Pharmacol [Internet] 9 (4) (2019) [cited 2024 Feb 28], https://www.longdom.org/open-access/a-review-on-prevalence-and-causes-of-peripheral-neuropathy-and-treatment-of-different-etiologic-subgroups-with-neurotropic-b-vitam-44217.html.
[2] Peripheral Neuropathy, National Institute of Neurological Disorders and Stroke, 2018.
[3] C. Hammi, B. Yeung, Neuropathy, in: StatPearls [Internet], StatPearls Publishing, Treasure Island (FL), 2024 [cited 2024 Feb 28]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK542220/.
[4] C.H. Gibbons, Diabetes and metabolic disorders and the peripheral nervous system, Continuum 26 (5) (2020 Oct) 1161–1183.
[5] R.V. Tuckson, M. Edmunds, M.L. Hodgkins, Telehealth, N. Engl. J. Med. 377 (16) (2017 Oct 19) 1585–1592.
[6] M.J. Field, Telemedicine I of M (US) C on ECA, in: Telemedicine: A Guide to Assessing Telecommunications in Health Care [Internet], National Academies Press (US), 1996 [cited 2024 Feb 28]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK45440/.
[7] S.N. Gajarawala, J.N. Pelkowski, Telehealth benefits and barriers, J. Nurse Pract. 17 (2) (2021 Feb) 218–221.
[8] A. Haleem, M. Javaid, R.P. Singh, R. Suman, Telemedicine for healthcare: Capabilities, features, barriers, and applications, Sens Int 2 (2021) 100117.
[9] M. Balestra, Telehealth and Legal Implications for Nurse practitioners, J. Nurse Pract. 14 (1) (2018 Jan 1) 33–39.
[10] R. Hanewinckel, M. van Oijen, M.A. Ikram, P.A. van Doorn, The epidemiology and risk factors of chronic polyneuropathy, Eur. J. Epidemiol. 31 (1) (2016 Jan) 5–20.
[11] A. Burton, How do we fix the shortage of neurologists? Lancet Neurol. 17 (6) (2018 Jun 1) 502–503.
[12] T.M. Dall, M.V. Storm, R. Chakrabarti, O. Drogan, C.M. Keran, P.D. Donofrio, et al., Supply and demand analysis of the current and future US neurology workforce, Neurology 81 (5) (2013 Jul 30) 470–478.
[13] R. Lau, F. Stevenson, B.N. Ong, K. Dziedzic, S. Treweek, S. Eldridge, et al., Achieving change in primary care—effectiveness of strategies for improving implementation of complex interventions: systematic review of reviews, BMJ Open 5 (12) (2015 Dec 1) e009993.
[14] U.K. Misra, J. Kalita, P.P. Nair, Diagnostic approach to peripheral neuropathy, Ann. Indian Acad. Neurol. 11 (2) (2008) 89–97.
[15] A. Alexandru, I.M. Radu, M. Bizon, Big data in healthcare - Opportunities and challenges, Inf. Econ. 22 (2018 Jun 30) 43–54.
[16] K. Deldar, K. Bahaadinbeigy, S.M. Tara, Teleconsultation and clinical decision Making: a systematic review, Acta Inf. Med. 24 (4) (2016 Jul 16) 286–292.
[17] D.W. Hosmer, S. Lemeshow, R.X. Sturdivant, Applied Logistic Regression [Internet], first ed., Wiley Series in Probability and Statistics, Wiley, 2013 [cited 2024 Apr 30], https://onlinelibrary.wiley.com/doi/book/10.1002/9781118548387.
[18] N.A. Visser, N.C. Notermans, R.S.N. Linssen, L.H. van den Berg, A.F.J.E. Vrancken, Incidence of polyneuropathy in Utrecht, The Netherlands, Neurology 84 (3) (2015 Jan 20) 259–264.
[19] R. Hanewinckel, J. Drenthen, M. van Oijen, A. Hofman, P.A. van Doorn, M.A. Ikram, Prevalence of polyneuropathy in the general middle-aged and elderly population, Neurology 87 (18) (2016 Nov 1) 1892–1898.
[20] M. Breton, E.E. Sullivan, N. Deville-Stoetzel, D. McKinstry, M. DePuccio, A. Sriharan, et al., Telehealth challenges during COVID-19 as reported by primary healthcare physicians in Quebec and Massachusetts, BMC Fam. Pract. 22 (1) (2021 Sep 26) 192.
[21] S. Popescu, B. Timar, F. Baderca, M. Simu, L. Diaconu, I. Velea, et al., Age as an independent factor for the development of neuropathy in diabetic patients, Clin. Interv. Aging 11 (2016 Mar 15) 313–318.
[22] K. Lam, A.D. Lu, Y. Shi, K.E. Covinsky, Assessing telemedicine Unreadiness Among older adults in the United States during the COVID-19 pandemic, JAMA Intern. Med. 180 (10) (2020 Oct 1) 1389–1391.
[23] A. Abraham, C. Barnett, H.D. Katzberg, L.E. Lovblom, B.A. Perkins, V. Bril, Sex differences in neuropathic pain intensity in diabetes, J. Neurol. Sci. 388 (2018 May 15) 103–106.
[24] F. Lavaee, S. Didar, A. Afshari, Evaluation of the serum level of estrogen, progesterone, prolactin, and testosterone in patients with trigeminal neuralgia compared to a healthy population, Clin Exp Dent Res 9 (6) (2023 Dec) 1200–1205.
[25] A. Singh, N. Asif, P.N. Singh, M.M. Hossain, Motor nerve conduction velocity in Postmenopausal Women with peripheral neuropathy, J. Clin. Diagn. Res. 10 (12) (2016 Dec) CC13–C16.
[26] H.B. Edwards, E. Marques, W. Hollingworth, J. Horwood, M. Farr, E. Bernard, et al., Use of a primary care online consultation system, by whom, when and why: evaluation of a pilot observational study in 36 general practices in South West England, BMJ Open 7 (11) (2017 Nov 1) e016901.
[27] K. Ufholz, A. Sheon, D. Bhargava, G. Rao, Telemedicine Preparedness Among older adults with chronic Illness: Survey of primary care patients, JMIR Form Res 6 (7) (2022 Jul 27) e35028.
[28] S. Kumar, A. Kumar, M. Kumar, A. Kumar, R. Arora, R. Sehrawat, Feasibility of telemedicine in maintaining follow-up of orthopaedic patients and their satisfaction: a preliminary study, J Clin Orthop Trauma 11 (Suppl 5) (2020 Oct) S704–S710.
[29] G.G. Sari, W. Wirman, Telemedicine sebagai Media Konsultasi Kesehatan di Masa Pandemic COVID 19 di Indonesia, Jurnal Komunikasi 15 (1) (2021 Jun 3) 43–54.
[30] Y. Pappas, J. Vseteckova, N. Mastellos, G. Greenfield, G. Randhawa, Diagnosis and decision-Making in telemedicine, J Patient Exp 6 (4) (2019 Dec) 296–304.
[31] M. Davari, E. Khorasani, B.M. Tigabu, Factors influencing prescribing decisions of physicians: a review, Ethiop J Health Sci 28 (6) (2018 Nov) 795–804.
[32] H. Yang, G. Sloan, Y. Ye, S. Wang, B. Duan, S. Tesfaye, et al., New Perspective in diabetic neuropathy: from the Periphery to the Brain, a Call for early detection, and Precision medicine, Front. Endocrinol. 10 (2019) 929.
[33] P. Shillo, G. Sloan, M. Greig, L. Hunt, D. Selvarajah, J. Elliott, et al., Painful and Painless diabetic neuropathies: what is the difference? Curr Diab Rep 19 (6) (2019 May 7) 32.
[34] N.E. Cameron, S.E. Eaton, M.A. Cotter, S. Tesfaye, Vascular factors and metabolic interactions in the pathogenesis of diabetic neuropathy, Diabetologia 44 (11) (2001 Nov) 1973–1988.
[35] E.L. Feldman, K.A. Nave, T.S. Jensen, D.L.H. Bennett, New Horizons in diabetic neuropathy: Mechanisms, Bioenergetics, and pain, Neuron 93 (6) (2017 Mar 22) 1296–1313.
[36] G. Sloan, D. Selvarajah, S. Tesfaye, Pathogenesis, diagnosis and clinical management of diabetic sensorimotor peripheral neuropathy, Nat. Rev. Endocrinol. 17 (7) (2021 Jul) 400–420.
[37] P. Bouche, Neuropathy of the elderly, Rev. Neurol. 176 (9) (2020 Nov 1) 733–738.
[38] D. Bates, B.C. Schultheis, M.C. Hanes, S.M. Jolly, K.V. Chakravarthy, T.R. Deer, et al., A comprehensive Algorithm for management of neuropathic pain, Pain Med. 20 (Suppl 1) (2019 Jun) S2–S12.
[39] Y. Sethi, N. Uniyal, V. Vora, P. Agarwal, H. Murli, A. Joshi, et al., Hypertension the 'Missed Modifiable risk factor' for diabetic neuropathy: a systematic review, Curr. Probl. Cardiol. 48 (4) (2023 Apr 1) 101581.
[40] A.I. Vinik, M.L. Nevoret, C. Casellini, H. Parson, Diabetic neuropathy, Endocrinol Metab. Clin. N. Am. 42 (4) (2013 Dec) 747–787.
[41] Konsil Kedokteran Indonesia, Standar Kompetensi Dokter Indonesia, second ed., Jakarta, 2012.
[42] P. Siao, M. Kaku, A Clinician's approach to peripheral neuropathy, Semin. Neurol. 39 (5) (2019 Oct) 519–530.
[43] J.C. Watson, P.J.B. Dyck, Peripheral neuropathy: a practical approach to diagnosis and symptom management, Mayo Clin. Proc. 90 (7) (2015 Jul) 940–951.

[44] J.L. Larochelle, D.E. Feldman, J.F. Levesque, The primary-specialty care interface in chronic diseases: patient and practice characteristics associated with co-management, Healthc. Policy 10 (2) (2014 Nov) 52–63.
[45] American Diabetes Association, 11. Microvascular complications and Foot care: standards of medical care in diabetes-2021, Diabetes Care 44 (Suppl 1) (2021 Jan) S151–S167.
[46] A. Pfannkuche, A. Alhajjar, A. Ming, I. Walter, C. Piehler, P.R. Mertens, Prevalence and risk factors of diabetic peripheral neuropathy in a diabetics cohort: Register initiative "diabetes and nerves", Endocrine and Metabolic Science 1 (1) (2020 Jul 1) 100053.
[47] J.H. McArthur, The reliability and validity of the subjective peripheral neuropathy screen, J. Assoc. Nurses AIDS Care 9 (4) (1998) 84–94.
[48] M.J. Young, A.J. Boulton, A.F. MacLeod, D.R. Williams, P.H. Sonksen, A multicentre study of the prevalence of diabetic peripheral neuropathy in the United Kingdom hospital clinic population, Diabetologia 36 (2) (1993 Feb) 150–154.
[49] E.J. Bastyr, K.L. Price, V. Bril, MBBQ Study Group, Development and validity testing of the neuropathy total symptom score-6: questionnaire for the study of sensory symptoms of diabetic peripheral neuropathy, Clin. Therapeut. 27 (8) (2005 Aug) 1278–1294.
[50] R. Hanewinckel, M.A. Ikram, P.A. van Doorn, Assessment scales for the diagnosis of polyneuropathy, J. Peripher. Nerv. Syst. 21 (2) (2016 Jun) 61–73.
[51] A.M. Wilson, M.K. Ong, D. Saliba, N.I. Jamal, The Veterans Affairs neuropathy Scale: a reliable, remote polyneuropathy Exam, Front. Neurol. 10 (2019 Nov 1) 1050.
[52] A.M. Wilson, N.I. Jamal, E.M. Cheng, M. Inkelas, D. Saliba, A. Hanssen, et al., Teleneurology clinics for polyneuropathy: a pilot study, J. Neurol. 267 (2) (2020) 479–490.