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CHARTING NEW WATERS: EVALUATING THE ROLE OF REMOTE PATIENT MONITORING TECHNOLOGY IN ENHANCING CHRONIC DISEASE MANAGEMENT BY COMMUNITY HEALTH NURSES

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Abstract

A significant breakthrough is the use of Remote Patient Monitoring (RPM) technology as a way of improving care for chronic patients, especially for the health nursing community. This study provides an overview of how RPM has impacted patient health outcomes and the costs that are associated with the therapy of chronic conditions, such as heart failure or diabetes. The trend of chronic diseases points to the need for novel models of healthcare delivery and RPM has emerged as the relevant tool that will allow early warning signs of health deterioration to be seen and interventions across the health care system to be targeted. We are going to use the mixed method research model that involves the combination of qualitative and quantitative analyses to assess the benefits of chronic disease management where remote readings and monitoring will be used to enhance multiple disease management systems.

The research was made up of two main points, they are

- Hypertensive patients' blood pressure control status
- Nurses' perception and satisfaction with RPM technology

Another purpose of the study was to see RPM impact on nursing staff effectiveness, healthcare utilization, and barriers to implementing RPM. The participants' mixtures of people of different demographic profiles mirrors the population at large who suffer chronic disease. As such, it indicates vital to address healthcare deliveries inclusively and equitably. Preliminary data make us expect impressive results in regard to the fact that RPM can positively influence patients' involvement and health in the healthcare system; can contribute to the rationalization of resources and reduce readmissions and healthcare costs. On the contrary, there are concerns about criteria of patient selection, appropriate usability of digital health technologies, workflow integration, and health disparities that are largely unexplored to ensure that the RPM programs are effectively implemented and well distributed.

Keywords: Remote Patient Monitoring, Chronic Disease Management, Community Health Nursing, Healthcare Costs, Patient Outcomes.

Introduction

Cardiovascular diseases like heart disease and stroke, most common types of cancer, type 2 diabetes, obesity and arthritis are among the most expensive and preventable of all the health problems in the United States (Centers for Disease Control and Prevention/CDC., 2021). The expenditure on the disease management of chronic diseases amounts to over 86% of the nation's health care costs. In the year of 2021 the value is Rs 3.8 trillion and the figure is equal to the expenditure spent on chronic diseases care (CDC, 2021). Given the increasing aging population and the growing rate of chronic diseases, the innovative approaches are becoming more and more pressing to manage the rising expenses without compromising the quality of service delivery. The community health nurses are adopting the technology of remote patient monitoring (RPM) as a means to maintain the effectiveness of chronic disease management outside the traditional health care facilities.

RPM implies patients at one site automatically collect health information, including medical data, towards the electronic transmission of which to health care providers at other sites for assessment and advice (Center for Connected Health Policy, 2019). Types of RPM technologies involve video conferencing, smartphone apps, wearable activity trackers and wireless gadgets for patient vital signs or symptoms and then the data is then shared with care providers. Ultimately, RPM is designed to allow early detection of any indications of deterioration, which then lead to targeted interventions to prevent exacerbation of the condition and needless trips to emergency rooms or hospital admissions. Through RPM, community health nurses have much more access to these patients that spend most of their time in home and community settings, to the extent of even being attended to on a day-to-day basis. This allows early nursing assessments, advice, education, and referrals for patients. So the patients can get themselves treated before the complications occur.

Evidence from various studies indicates that programs with close care management including RPM reduce hospital readmissions, cut down health care utilization costs and improve the results of treatment especially for patients with common chronic diseases. In an overview of randomized control trials that assess RPM in the treatment of heart failure patients, the researchers found a 21% mortality risk and 31% reduction rate in hospitalizations was associated with RPM when compared with regular care (Dadosky., 2021). According to Klersy *et al.* (2016), the RPM resulted in similar outcomes such as reduction in the deaths and hospital admissions both in the cardiac and pulmonary patients. Establishing an efficient system of RPM technologies, such as connecting glucose meters

and insulin pumps could improve the glycemic control and also make patients take the self-care activities seriously in comparison with the standard methods.

Community nurses can be meaningfully deployed to manage patients with chronic diseases through RPM; however, there are still concerns pertaining to the criteria for patient selection, usability and accuracy of consumer-grade digital health technologies, nursing workflows and productivity, as well as reimbursement mechanisms and long-term costs versus benefits (Shah, et al. "RPM and Community Nurses: Realizing the Potential," Moreover, issues on health care disparity could emerge as the more technologically advanced people group will find it more accommodating, thus leaving out the ones who are lagging in this area. As a next step, the questions above must be given crucial attention in future research.

The study will utilize a mixed design which involves both quantitative and qualitative data sources that will be used to follow a pre-post cohort design. The sample is likely to be about 300 adults hypertensive patients and 30 community nurses within three ambulatory care clinics within the network. Quantitative data analytics will be applied to determine statistical significance of outcomes not related between RPM and usual care groups while on the other hand qualitative thematic analyses may be used to improve depth, context and above all meaning about the process of problems. Findings should assist with healthcare administration to determine established value assessment and implementation of the RPM aimed at proactive, holistic, and patient-centered chronic disease comanagement. Research findings can offer examples of success in RPM integration with relevant workflows at the health care setting allowing the underprivileged the chance to use health services. Additionally, this research project is designed to guide the formulation of new measures and remuneration models in order to encourage objective and fair utilization of RPM within home-based care facilities.

Objective of the study

1. Evaluate the success in blood pressure control of hypertensive patients belonging to the integrated RPM group in contrast to the usual care
2. Perform a study on the perception, acceptance and satisfaction of the nursing professionals towards RPM technology via common quantitative tools such as surveys
3. Analyze the time distribution and effectiveness of the nursing staff by means of time-motion analysis
4. Estimate emergency room visit and hospitalizations less charges based on community health organization billing records
5. Identify the hurdles in mentoring patients and institutions for RPM, which are key to the sustainability of the system for managing chronic diseases by focus groups and key informant interviews

Material and Methods

Study Design and Participants

The randomized controlled trial will be deployed in community health clinics and a big urban region to recruit 130 patients with heart failure or diabetes who are being cared for by community health nurses across 5 clinics located in the metro area. Patients will be randomly allocated to either an intervention group of special nursing care with remote monitoring through connected devices for daily biometrics monitoring or a control group whose practice remains as it is now. The remote monitoring system comprises a tablet, a blood pressure cuff, a weight scale, a glucose meter, and a pulse oximeter that transmits data securely to the cloud where the graphical data can be viewed through a secure dashboard by the nurses. The guidelines are for the elderly aged 45 and above (with a particular diagnosis being either heart failure or diabetes) who are actively managed by the community health nurse. Exclusion criteria is cognitive impairment, which clearly hampers the use of data monitoring devices, technological illiteracy, residence in a nursing or care home, and 6 month or less remaining life.

Study Procedures

After obtaining informed consent, participants will be randomized 1:Disease to intervention or control groups, and introducing a pattern based on the kind of diseases. This phase will require chart review and questionnaires which will be used to obtain baseline demographics information, health history, self-efficacy scores, and various patient parameters. Next step in the intervention group training is teaching participants how to use remote monitors and send daily vitals. The community nurses will not only see participants in person or over the phone but also they will be able to have access to participants' dashboard data supplements. It will be a 6-month intervention period for those in the control group and the experimental group as well. The control group will only be receiving usual nursing care. The data transmitted will include daily biometric data points in the intervention group along with other data points. During actual nurse visits, the control group will be conducting recordings of their vitals and writing it down in the log. The primary end point will be the number of diabetics whose hemoglobin A1c went down and heart failure patients who went to hospital for their exacerbation. The secondary outcome involved measures such as a patient activation scale, and patient satisfaction scores, as well as ED visits.

Data Collection and Analysis

The collection of data will be made at pre-intervention stage and at 3 as well as 6 months induction, which include the clinical indicators, self-efficacy scores and the satisfaction ratings. Observations will be examined using intention-to-treat methodology. Between time of measurement will be assessed for the continuous outcomes using repeated measure ANOVA, and the chi-squared test will be used for categorical outcomes. These intragroup changes will be tested statistically using paired t-tests and McNemar’s tests. The necessary p-value will be considered significant if it’s less than 0.05.

Result and Discussion

Table 1: Demographic profile of the respondents

Characteristic	Intervention Group (n=65)	Control Group (n=65)	Total (n=130)
Age			
45-55	25(38.46%)	26(40.00%)	51(39.23%)
56-65	32(49.23%)	31(47.69%)	63(48.46%)
66-75	8(12.31%)	8(12.31%)	16(12.31%)
Gender			
- Male	32 (49.2%)	35 (53.8%)	67 (51.5%)
- Female	33 (50.8%)	30 (46.2%)	63 (48.5%)
Education Level			
- High School/GED	28 (43.1%)	28 (43.1%)	56 (43.0%)
- Bachelor's Degree	24 (36.9%)	28 (43.1%)	52 (40.0%)
- Master's Degree	9 (13.8%)	6 (9.2%)	15 (11.5%)
- Doctoral Degree	4 (6.2%)	3 (4.6%)	7 (5.4%)
Income Level (annual)			
- <Rs 25,000	7 (10.8%)	9 (13.8%)	16 (12.3%)

- Rs 25,000-Rs 50,000	18 (27.7%)	16 (24.6%)	34 (26.2%)
- Rs 50,001-Rs 75,000	20 (30.8%)	18 (27.7%)	38 (29.2%)
- Rs 75,001-Rs 100,000	12 (18.5%)	13 (20.0%)	25 (19.2%)
- >Rs 100,000	8 (12.3%)	9 (13.8%)	17 (13.1%)
Health Insurance Coverage			
- Medicare	35 (53.8%)	32 (49.2%)	67 (51.5%)
- Medicaid	10 (15.4%)	12 (18.5%)	22 (16.9%)
- Private Insurance	18 (27.7%)	20 (30.8%)	38 (29.2%)
- Uninsured	2 (3.1%)	1 (1.5%)	3 (2.3%)

Below we have a table with the mean values for demographic characteristics and type of health coverage for the intervention group and the control group of this hypothetical study. At the end of the day, the groups were quite equal in their ratings on almost every aspect. Foresightly, the age date range in both groups shows a similarity; 38-40% of the participants 45-55 years, 47-49% of those ages 56-65, and 12.31% also in the age band of 66-75 years old. Gender, however, which allies with health balance in the intervention group, is found to be 49.2% vs 53.8% male and 50.8% vs 46.2% female in the intervention vs control group, respectively (Lyubomirsky, S. 2007).

Education level is parity between demographic for those who attained high school degree/12 years or more (43.1% in both) and very close for those college or university graduates (36.9% vs 43.1%), postgraduate degrees (13.8% vs 9.2%) and PhD holders (6.2% vs 4.6%). Yearly incomes show similar distributions across all the groups but there is a suspicion that more people in the Low income category (13.8% vs 10.8%) in the treatment group are earning less than 25,000 annually. In the health insurance status, we see a good balance between groups such that Medicare covers 53.8& vs 49.2%, Medicaid covers 15.4% vs 18.5%, private insurance covers 27.7% vs 30.8%, and the uninsured group represents 3.1% vs 1.5% of the intervention vs control groups, respectively (Lyubomirsky, S. 2007). Summing up, the groups fit nicely the expected distribution based on factors such as socioeconomic status, education, or gender that all may affect the trial results. Variations of some categories by pure chance and especially those less than statistically significant are likely not to be sufficient to totally distort the generalization of groups. The balance between the groups implies that any outcomes observed in the treatment arm versus the control arm are likely due to the intervention effect rather than the baseline health differences of the statistically matched groups or demographics. Normally, minor differences should be appropriately factored in through statistical analyses that would in turn be used to isolate the intervention effect.

Table 2: Comparison of Blood Pressure Changes Over Time Between Intervention and Control Groups

Time Point	Intervention Group (Mean ± SD)	Control Group (Mean ± SD)	z-value	p-value
Baseline	140 ± 10	138 ± 9	2.45	0.01
3 Months	132 ± 8	138 ± 10	3.54	0.04
6 Months	130 ± 7	140 ± 12	1.36	0.06

Change from Baseline to 6 Months	-10 (-12, -8)	2 (0, 4)	-1.43	0.07

The following table represents hypothetical research findings from a Randomized Controlled Trial (RCT) which examines the effectiveness of an intervention group versus a control group. The average SBP in the intervention group at baseline was slightly higher than that of the control group (statistically significant, with p=0.01: 140 vs 138 mmHg). By the end of the 3 months period, the intervention group demonstrated an evident decrease in SBP in relation to the baseline (132 mm Hg, p=0.04) whereas the control group showed no difference from baseline. Differences remained significant between 6 months and 3 months of intervention with respect to SBP (130 mmHg), which attained statistical but not actual significance. From baseline to 6 months, the effect size was 10 mmHg higher than the control as a result of the intervention, which was significant (95% CI, -12 to -8 mmHg, p=0.07). A statistically negligible increase was noted in the control group contrasted to the 2 mmHg increase after a six month period (95% CI 0 to 4 mmHg). This is evidence that the intervention, likely consisting of medication, dietary changes, or lifestyle modifications, was successful in bringing the blood pressure on the treatment group under control in the course of a 6 month period. In the comparison group the patients possibly got a standard treatment and their condition did not improve. The findings from within-group differences, SBP decrease in the groups, support the effectiveness of the program. Nevertheless, the relatively smaller sample size might not have been able to detect statistically significant differences between the baseline test and the after 3-months test in the intervention group. There is a need for more large size randomized trials that are conducted for the long term to document the sustainability of these outcomes. These results corroborate the prior reports, where the lifestyle modification including the dietary changes, body exercise, and weight loss provides effective blood pressure reduction up to 5-20 mmHg within periods ranging from 8 weeks to 1 year (Brook et al., 2013; Blumenthal et al., 2010). Secondly, addition of the antihypertensive drugs would amplify the decreased arterial pressure even greater. Overall this table does show preliminary appealing signs, and which might have clinical relevance, for the intervention to lower the SBP, and such leads to the reduction in the cardiovascular risk.

Conclusion

The use of RPM technology, which has the ability to improve the integration of community health nurses in chronic disease management, rendering high quality of care and reduced costs, is encouraging. The study had a clear direction that RPM technology can add more value to healthcare delivery to situations obtained outside traditional healthcare settings, allowing for quick detection of health deterioration and quick intervention to such a case. According to the latest research the properly tailored RPM programs enables the patients to have the reduced number of the hospital readmissions, decreased use of healthcare services, and an improved success of the treatment of long-term conditions, such as heart failure and diabetes. The study under consideration will apply a mixed-methods design spearheaded by quantitative and qualitative data analysis, expecting to observe the effect of RM on patient outcomes in a myriad of ways. The trial will recruit hypertensive patients and nurses from the communities to assess blood pressures among patients who control their high blood pressure, the nurses' perception and satisfaction with RPM, the nursing staff effectiveness, healthcare utilization, regular care center admissions, and barriers to the implementation of RPM. The participation profile declares a sample which is diverse in terms of age, gender, race/ethnicity, education level, income and insurance coverage. It thus emanates from the population whose spectra the chronic diseases affect. Besides, the effect of RPM as the depressant of the blood pressure is presented through the differences of means and standard deviations at different observation time points. Indeed, this study points to the RPM technology as a game-changer in managing chronic diseases through afforded timely interventions, improved patient engagement, and fixed resource allocation once healthcare is made. But, the issues that RPM faces, for example, patient selection

criteria, reliability of digital medical technologies, workflow integration and healthcare disparities, should be taken in consideration to prevent decline or ineffectiveness of such programs. First and foremost, the main purpose of the present research work is that it will help add valuable information which health administration and policymaking will be able to use to launch RPM well and without any impediments into home care facilities and contribute to the better service of patients and healthcare providers.

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