A Study to Assess Effectiveness of Individual Planned Teaching on Self-Administration of Insulin for Patients with Diabetes Mellitus in Selected Hospitals of Madhya Pradesh

Abstract

A research study assessed individual planned teaching (IPT) effectiveness in knowledge and skill development for insulin self-administration among diabetic patients in specific hospitals throughout Madhya Pradesh India. An IPT intervention was delivered to 60 diabetes mellitus patients who required insulin therapy through a pre-test/post-test design. The researchers used knowledge questionnaires and skill observation checklists for data collection before intervention then again during immediate periods and at 4-weeks post-intervention. Study results showed important advancements in patient knowledge (p<0.001) and skill performance (p<0.001) after the intervention which persisted at the 4-week follow-up assessment. The demographic variables which affected learning outcomes were education level and experience with insulin use (p<0.05). The research demonstrates that specific educational strategies delivered to individual patients enhance their insulin therapy skills thus leading to fewer complications and higher quality of life in patients with diabetes living in resource-constrained areas.

Keywords: Diabetes mellitus, insulin therapy, self-administration, patient education, nursing intervention

Introduction

Diabetes mellitus stands as a major worldwide health threat during the 21st century because developing nations face changing lifestyles together with fast-paced urbanization. Research from International Diabetes Federation (IDF) 2023 demonstrates that the current number of diabetic individuals in India reaches 77 million but scientists expect this figure to grow to 134 million by 2045. The state of Madhya Pradesh in India reports growing diabetes rates that have reached an alarming 8.7% in urban areas alongside 4.3% in rural areas according to research by Anjana et al. (2021).

Disease management for patients with diabetes mellitus requires insulin therapy as a crucial element especially for patients who have Type 1 diabetes and advanced Type 2 diabetes. Insulin therapy achieves its full capacity through correct administration methods. Patients who perform insulin incorrectly will encounter inferior blood sugar regulation alongside higher complication risks and reduced life quality (Frid et al., 2020).

Research shows continuously that patients demonstrate knowledge and skill deficiencies when it comes to insulin self-administration. The self-administration practices of insulin users in India showed at least one critical error in a multi-center study covering various locations with 64.5% of patients exhibiting these errors (Kalra et al., 2022). The errors involved using the wrong injection site while also inserting the needle at an incorrect angle along with mixing cloudy insulin improperly and storing insulin incorrectly.

The low literacy rates within Madhya Pradesh create a severe problem because people in rural and semi-urban areas receive scarce access to specialized diabetes education and its resources. According to Singh et al. (2021), structured insulin administration education was provided to 31% of insulin-using patients assessed at major Bhopal hospital diabetes departments.

Multiple research studies demonstrate that structured education programs lead to strong improvements in diabetes self-management among patients including the skills needed to administer insulin. Research involving diabetes education programs primarily takes place within organizations that maintain substantial resources. Research investigating individual planned teaching interventions which suit the socio-cultural demands of central India especially Madhya Pradesh remains scant.

The study fills an existing knowledge gap because it evaluates how a personalized educational intervention supports insulin self-management skills in diabetic patients throughout Madhya Pradesh hospitals. The research adds to developing proven educational strategies for diabetes care by supporting local practices which healthcare providers can use in common routine care throughout resource-constrained locations.

Research Objectives

1. The study aims to understand patients with diabetes mellitus who self-administer insulin in selected hospitals across Madhya Pradesh regarding their initial knowledge and skill levels.

2. Individual planned teaching of insulin self-administration methods will be developed then implemented for diabetes patients.

3.An assessment of the planned teaching effectiveness will be made through knowledge and skill comparison between subjects before and after intervention.

4. An assessment aims to determine the effects of demographic variables on patient learning outcomes regarding insulin self-administration.

Literature Review

Global Perspectives on Insulin Self-Administration Education

Researches worldwide have confirmed that patient education stands essential for diabetes self-management. The systematic review conducted by Chrvala et al. (2021) evaluated 118 studies to demonstrate that diabetes self-management education successfully improved patient blood glucose control and this effect was stronger among interventions delivering more than 10 hours of personal contact time. The meta-analysis performed by Fu et al. (2020) on 23 randomized controlled trials proved structured educational programs for insulin injection lead to better glycemic control (mean HbA1c reduction of 0.8%, p<0.001) in addition to lowering injection-related complications.

Indian Context of Diabetes Self-Management Education

Indian research investigations reveal specific obstacles which affect insulin self-injection practices. The study performed by Bhutani et al. (2021) across five Indian states demonstrated that more than seven in ten insulin users received no formal education about appropriate injection practices. A study revealed that 82.4% of patients re-used needles and a further 56.7% failed to correctly change their injection sites while 43.2% stored their insulin in inappropriate conditions.

Sharma and colleagues (2022) performed a qualitative examination of treatment barriers among North Indian insulin users through which they determined that inadequate education coupled with fear of injections and misbelief about insulin stood as main impediments to effective therapy. The authors support a new approach for educational programs which must both educate individuals regarding insulin therapy and help patients overcome their mental blocks related to the therapy.

Educational Interventions for Insulin Self-Administration

Different educational strategies have undergone evaluation to enhance patient capabilities in administering insulin. Joshi et al. (2021) assessed a study where 120 people in Maharashtra received individual (85% accurate) or group teaching (72%) about insulin administration techniques and discovered individual instruction led to superior results (p=0.03).

When resources are limited as they are in parts of Madhya Pradesh Kumar and Verma (2023) provided a nursing intervention that combined demonstration and return demonstration methods. The intervention used quasi-experimental design and involved 80 participants leading to a substantial improvement in patient insulin self-administration abilities following the intervention as correct technique presentation rose from 23% to 78% among participants.

Gaps in Literature

Contrary to extensive research done on diabetes self-management education multiple research gaps persist particularly within Madhya Pradesh. The majority of research in India has been conducted in metropolitan regions yet there is lacking evidence from central Indian states particularly Madhya Pradesh which shows dissimilar health system resources and literacy rates. The follow-up assessments for evaluating the long-term impact of educational effects are rare in the current research. The relationship between population traits and academic success outcomes from Madhya Pradesh exhibits no previous investigation.

The present research fills this knowledge gap through a designed teaching approach that suits Madhya Pradesh patients' needs followed by both immediate and extended (4-week) assessment of patient understanding.

Conceptual Framework

The investigation adheres to the theories of Dorothea Orem's Self-Care Deficit Nursing Theory to demonstrate that individuals need nursing care when they cannot provide continuous self-care. Through its presentation of self-care alongside self-care deficit and nursing systems the theory outlines how nurses can help patients meet their self-care demands for insulin administration.

The individual planned teaching intervention means a nursing system based on supportive-educative principles that helps patients learn and perform insulin administration effectively. The intervention delivers formal education while demonstrating proper skills and requiring patients to show they have learned these techniques to build their ability for healthcare self-care.

Methodology

Research Design

The study assessed individual planned teaching intervention effectiveness by applying a quasi-experimental pre-test/post-test design. The authors selected this research design because it works well for clinical educational assessments when randomization proves impossible or unethical.

Setting

The study was conducted in the diabetes outpatient departments of three tertiary care hospitals in Madhya Pradesh:

1. Hamidia Hospital, Bhopal
2. MY Hospital, Indore
3. Netaji Subhash Chandra Bose Medical College Hospital, Jabalpur

These settings were selected to ensure representation of diverse patient populations from different geographical areas of the state.

Sample

Sample Size Calculation

The study determined sample size by running G\*Power analysis on previous study results. The determined requisite participant total of 52 emerged from sample size estimations using an effect size of 0.4 and α error probability of 0.05 and power (1-β) of 0.80. A total sample of 60 participants was established after considering possible participant dropouts.

Sampling Technique

Purposive sampling was used to select participants who met the following inclusion criteria:

* Diagnosed with diabetes mellitus (Type 1 or Type 2)
* Prescribed insulin therapy (newly initiated or ongoing)
* Aged 18 years or older
* Able to communicate in Hindi or English
* Willing to participate in the study

Patients with severe physical limitations preventing self-administration of insulin, those with cognitive impairment, and those unwilling to return for follow-up were excluded from the study.

Data Collection Tools

Tool 1: Demographic and Clinical Data Questionnaire

The assessment incorporated information about patient values such as age together with gender and educational background and occupational status and diabetes duration and insulin treatment history and insulin type and prior insulin instruction.

Tool 2: Knowledge Assessment Questionnaire

A 25-question multiple-choice assessment was developed to evaluate healthcare students about insulin therapy, storage, preparation, administration method, site rotation, complications and troubleshooting aspects. The participants received one point for correct answers and the quiz contained twenty-five possible questions. Research data split participants into three knowledge groups:

* + Poor: ≤50% (0-12 points)
	+ Average: 51-75% (13-18 points)
	+ Good: >75% (19-25 points)

Tool 3: Skill Assessment Checklist

The observational tool comprised 15 steps which focused on insulin self-administration. The evaluators assigned points ranging from zero to two to each step on the assessment.

* 0: Not performed
* 1: Performed incorrectly/incompletely
* 2: Performed correctly

Immediately after completion a maximum 30 points scored for the assessment. Skill performance was categorized as:

* Poor: ≤50% (0-15 points)
* Average: 51-75% (16-22 points)
* Good: >75% (23-30 points)Validity and Reliability

validity

The tools achieved content validity through assessments conducted by five professionals who included endocrinologists, diabetes nurse educators and nursing faculty. The knowledge questionnaire achieved acceptable reliability based on the Kuder-Richardson formula 20 (KR-20) which produced a coefficient of 0.84. The skill assessment checklist achieved high reliability through inter-rater reliability testing which produced a Cohen's kappa value of 0.89.

Intervention Protocol

The individual planned teaching (IPT) program originated from literature research together with professional guidance and patient requirement assessments. The program consisted of:

1 Educational Session (30-40 minutes):

* One-to-one teaching using standardized content
* Standardized content was complemented with flipcharts and insulin administration models during the teaching session.
* Discussion of basic diabetes concepts, insulin types, storage, preparation, and administration techniques

2. Demonstration (15-20 minutes):

* Step-by-step demonstration of insulin preparation and administration
* Use of insulin pens and syringes as per the patient's prescription

3. Return Demonstration (20-30 minutes):

The patient demonstrates their insulin administration skills in front of the healthcare provider as part of supervised practice.

* Feedback and correction provided
* Additional practice opportunities as needed

4. Educational Materials:

* Illustrated handouts in Hindi and English
* Simplified instructions for home reference

Data Collection Procedure

After obtaining ethical clearance and institutional permissions, participants were recruited from the outpatient departments of the selected hospitals. Written informed consent was obtained from all participants. The data collection process included:

1. Pre-test (Baseline):
	* Administration of demographic questionnaire
	* Assessment of baseline knowledge using Tool 2
	* Assessment of baseline skills using Tool 3
2. Intervention:
	* Implementation of the individual planned teaching program as described above
3. Immediate Post-test:
	* Assessment of knowledge using Tool 2
	* Assessment of skills using Tool 3
	* Conducted on the same day after completion of the teaching session
4. Follow-up Post-test:
	* Conducted 4 weeks after the intervention
	* Reassessment of knowledge using Tool 2
	* Reassessment of skills using Tool 3

Ethical Considerations

The institutional ethics boards from each medical facility approved the research project. Participants received informed consent from the researchers who described both the research purpose and study procedures. Study participants received assurances of confidentiality benefits along with the right to leave the study whenever needed while their treatment remained unaffected. The standard educational intervention was implemented to patients from the control group following the study completion for ensuring equitable patient care.

Data Analysis

The data analysis process occurred using SPSS version 26.0. The statistical analysis included calculating frequencies as well as percentages and means alongside standard deviations for both demographic variables and test scores. The research utilized paired t-tests to judge knowledge and skill scores before and after the study. Repeated measures ANOVA served to analyze the changes in scores between pre-test and immediate and follow-up post-tests. Statistical tests analyzing knowledge and skill score modifications included Chi-square and ANOVA for measuring relationships with demographic information. Statistical significance was set at p<0.05.

Results

Demographic and Clinical Characteristics

Sixty patients engaged in the study and their ages averaged 52.7 years with standard deviation (SD) of 13.4. The research included 34 male participants who accounted for 56.7% of the total while 43.3% or 26 individuals belonged to the female demographic. Table 1 furnishes complete information about participant demographics and clinical data.

Table 1: Demographic and Clinical Characteristics of Participants (N=60)

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristic | Category | Frequency (n) | Percentage (%) |
| Age (years) | 18-30 | 5 | 8.3 |
|  | 31-45 | 14 | 23.3 |
|  | 46-60 | 28 | 46.7 |
|  | >60 | 13 | 21.7 |
| Gender | Male | 34 | 56.7 |
|  | Female | 26 | 43.3 |
| Education Level | No formal education | 11 | 18.3 |
|  | Primary | 18 | 30.0 |
|  | Secondary | 17 | 28.3 |
|  | Graduate and above | 14 | 23.3 |
| Occupation | Unemployed | 9 | 15.0 |
|  | Homemaker | 22 | 36.7 |
|  | Daily wage worker | 8 | 13.3 |
|  | Self-employed | 12 | 20.0 |
|  | Service | 9 | 15.0 |
| Duration of Diabetes | <1 year | 7 | 11.7 |
|  | 1-5 years | 19 | 31.7 |
|  | 6-10 years | 22 | 36.7 |
|  | >10 years | 12 | 20.0 |
| Duration of Insulin Therapy | Newly initiated (<1 month) | 13 | 21.7 |
|  | 1-12 months | 19 | 31.7 |
|  | >12 months | 28 | 46.7 |
| Type of Insulin Used | Regular insulin only | 8 | 13.3 |
|  | NPH insulin only | 5 | 8.3 |
|  | Premixed (30/70) | 31 | 51.7 |
|  | Basal-bolus regimen | 12 | 20.0 |
|  | Others | 4 | 6.7 |
| Previous Education on Insulin | None | 29 | 48.3 |
|  | Informal (by doctor/nurse) | 26 | 43.3 |
|  | Formal diabetes education | 5 | 8.3 |
| Mode of Administration | Insulin syringe | 42 | 70.0 |
|  | Insulin pen | 18 | 30.0 |

Baseline Knowledge and Skills

Most participants had insufficient insulin self-administration knowledge around 63.3% (n=38) while the remainder were split between average knowledge at 30.0% (n=18) and good knowledge at 6.7% (n=4). The participants scored an average of 10.85 points (standard deviation=3.62) at the study start out of 25 total points.

Insulin self-administration skill performance assessment indicated 41 participants (68.3%) had poor abilities, 16 participants (26.7%) showed average skills and only 3 participants (5.0%) had good performance. The participants scored an average of 13.73 points (SD=4.29) from a maximum 30 points at baseline assessment.

Effectiveness of the Individual Planned Teaching Intervention

Changes in Knowledge Scores

Knowledge scores increased significantly right after the intervention implemented a minimal additional gain at the 4-week follow-up. Participant knowledge scores improved substantially from 10.85 (SD=3.62) at the beginning to 19.77 (SD=2.84) right after the intervention and finally reaching 20.43 (SD=2.90) during 4-week follow-up. The data analysis through paired t-tests confirmed that participants scored significantly lower at the baseline than at the immediate post-test (t=-17.64, p<0.001) as well as at the baseline than at the follow-up (t=-18.92, p<0.001). A statistically important improvement was detected between the immediate post-test results and the follow-up results (t=-2.36, p=0.022).The changes in knowledge category distribution across the three time points are presented in Figure 1.



Figure 1: Changes in Knowledge Categories Across Time Points

[THIS IS FIGURE: A bar graph showing the percentage of participants in each knowledge category (Poor, Average, Good) at baseline, immediate post-test, and 4-week follow-up]

Changes in Skill Scores

The subject characteristics improved their skill performance in the same way they had improved their knowledge scores after receiving the intervention. Participants obtained above-average scores in their performance skills with measurements starting at 13.73 (SD=4.29) baseline then rising to 24.62 (SD=3.17) immediately after the intervention and maintaining 25.38 (SD=2.95) at the 4-week follow-up. The data revealed significant alterations in scores through paired t-tests which demonstrated a difference between baseline measurements and immediate post-test results (t=-19.85, p<0.001) as well as baseline scores and follow-up evaluations (t=-21.09, p<0.001). The research data showed progress between immediate post-test outcomes and follow-up measures with a statistically significant difference confirmed by a t-test score of -2.77 and p-value of 0.007.

The changes in skill category distribution across the three time points are illustrated in Figure 2.



Figure 2: Changes in Skill Categories Across Time Points

[THIS IS FIGURE: A bar graph showing the percentage of participants in each skill category (Poor, Average, Good) at baseline, immediate post-test, and 4-week follow-up]

Common Errors in Insulin Self-Administration

Insulin self-administration showed multiple shared mistakes in the skill assessment checklist at the initial testing phase. The frequency results for these errors appear in Table 2 both before and after the intervention process.

Table 2: Common Errors in Insulin Self-Administration Before and After Intervention

|  |  |  |  |
| --- | --- | --- | --- |
| Error | Baseline n (%) | Post-intervention n (%) | Follow-up n (%) |
| Improper hand hygiene | 42 (70.0) | 12 (20.0) | 8 (13.3) |
| Failure to check insulin expiry date | 51 (85.0) | 18 (30.0) | 21 (35.0) |
| Inadequate mixing of cloudy insulin | 39 (65.0) | 9 (15.0) | 11 (18.3) |
| Incorrect dose measurement | 32 (53.3) | 7 (11.7) | 9 (15.0) |
| Improper site selection | 45 (75.0) | 14 (23.3) | 17 (28.3) |
| Lack of site rotation | 47 (78.3) | 16 (26.7) | 19 (31.7) |
| Incorrect angle of needle insertion | 36 (60.0) | 11 (18.3) | 13 (21.7) |
| Failure to pinch skin properly | 43 (71.7) | 15 (25.0) | 14 (23.3) |
| No aspiration before injection | 52 (86.7) | 22 (36.7) | 25 (41.7) |
| Immediate needle withdrawal | 38 (63.3) | 10 (16.7) | 12 (20.0) |
| Rubbing injection site after administration | 49 (81.7) | 13 (21.7) | 16 (26.7) |
| Improper disposal of used needle | 54 (90.0) | 19 (31.7) | 22 (36.7) |

Influence of Demographic Variables on Learning Outcomes

Analysis of the relationship between demographic variables and improvement in knowledge and skill scores revealed several significant associations.

Education Level

Education levels proved a key factor in enhancing patient knowledge and clinical skills based on analysis findings (F=5.83, p=0.002 and F=4.91, p=0.004). Secondary education or higher participants showed significantly better improvement in knowledge and skill than those who attended no formal classes or stopped during primary school according to Tukey's HSD post-hoc analysis.

Previous Experience with Insulin

The time spent on insulin treatment drastically affected skill development results (F=3.76, p=0.029) although knowledge acquisition showed no such relationship (F=2.45, p=0.095). New insulin users demonstrated better skill improvements than individuals who received insulin for longer than one year following their initial prescription.

Previous Education on Insulin

The impact of prior insulin administration education led to better knowledge and skill development (F=4.32, p=0.018 and F=3.94, p=0.025). The subjects who entered without prior education demonstrated better improvement compared to those who received informal training which suggests informal training might sometimes solidify wrong practices.

Age, Gender, and Occupation

Age, gender, and occupation did not show statistically significant associations with improvement in knowledge or skills (p>0.05).

Discussion

Research findings showed that individual planned teaching effectively enhanced patients' knowledge and skills for insulin self-administration treatment in Madhya Pradesh diabetes mellitus patients. The study results show patients had large baseline knowledge deficits and skill deficiencies while the intervention generated major improvements which persisted until the 4-week evaluation period.

Baseline Knowledge and Skills

The research findings regarding substandard insulin usage knowledge and skills at baseline (63.3% and 68.3% respectively) support results from other studies based in India. According to Kalra et al. (2022) a total of 64.5% of insulin users from various Indian centers exhibited fundamental errors when performing their self-administration technique. Bhutani et al. (2021) reported that 71.3% of insulin users had not received any formal training for appropriate insulin injection techniques.

Similar to other Indian studies this investigation revealed the four particular errors which involved inadequate site rotation combined with improper needle insertion angle as well as subpar cloudy insulin mixing techniques and incorrect needle disposal methods. Evidence from this study demonstrates the pressing requirement for systematic programs which teach insulin injection skills to patients within this particular area.

Effectiveness of the Intervention

This study demonstrates that organized individualized instruction helps patients learn insulin self-administration with notably better knowledge and skills outcomes. The intervention led to rising mean knowledge scores from 10.85 (poor) to 19.77 (good) right after the intervention, followed by a minimal increase to 20.43 at the follow-up point. Immediately after the intervention patients exhibited increased skill competence represented by 24.62 (good) mean score that remained steady until follow-up through 25.38.

Our findings show a similar pattern of improvement as other research projects but our study demonstrates larger effect sizes. The nurses' educational intervention led to a technique improvement in patients from 23% to 78% according to Kumar and Verma (2023) which matched our study showing patients' "good skills" category rising from 5.0% to 76.7%.

The results from 4-week follow-up support the long-term retention of protocol-learning benefits thus indicating that educational intervention brings sustainable improvements. Several characteristics of our intervention including demonstration and return demonstration with illustrated handouts and individualized patient-specific teaching approaches contributed to sustained treatment effect.

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Influence of Demographic Variables

The observed associations between demographic variables and learning outcomes provide valuable insights for targeting and tailoring educational interventions. The significant influence of education level on both knowledge and skill improvement underscores the importance of adapting teaching methods for patients with limited formal education. This may include greater use of visual aids, simplified language, and additional practice opportunities.

The finding that newly initiated insulin users showed greater skill improvement compared to long-term users suggests that incorrect practices may become entrenched over time and more resistant to change. This highlights the importance of providing comprehensive education at the initiation of insulin therapy and periodic reinforcement thereafter.

The observation that patients with no previous education showed greater improvement than those with informal education raises concerns about the quality of informal instruction often provided during routine clinical encounters. Brief, unstructured advice during busy clinic visits may be insufficient and sometimes may reinforce incorrect practices.

Implications for Clinical Practice

This investigation yields multiple operational consequences which include:

1. Healthcare centers in Madhya Pradesh should combine structured insulin self-administration education into normal diabetes care during the start of insulin therapy delivery to patients.

2. The educational program must match individual reading proficiency to provide additional resources for people with lower education levels.

3. Hospital-based teaching of insulin self-administration should heavily utilize the demonstration and return demonstration method because it led to effective patient outcomes.

4. The focused teaching content should address the main errors from this study by instructing on correct site rotation techniques and showing how to insert the needle properly and properly mix cloudy insulin.

5. Handouts with illustrations in local languages should accompany verbal teaching as important supplementary materials to reinforce educational points.

6. Medical facilities should deliver education intermittently throughout follow-up care to preserve and boost knowledge retention throughout time spans.

Limitations

This study has several limitations that should be acknowledged:

1. Without a control group in pre-test/post-test assessments we cannot directly confirm whether the intervention caused the observed results rather than external causes.

2. The study lacks enough time since the post-intervention evaluation only spanned four weeks which might not discover durable knowledge and skill retention.

3. Individuals who consented to participate in the study might have greater self-motivation toward learning compared to ordinary insulin users.

4 The study failed to evaluate how participants used their improved knowledge and skills for glycemic control and complication reduction.

1. The study findings cannot be properly applied to rural populations since they stem from an urban population within specific socio-cultural contexts.

Conclusion

The results establish robust evidence about individual planned teaching success in developing insulin self-administration capability for diabetes mellitus patients residing in Madhya Pradesh. The positive effects of individualized structured education persist at the 4-week follow-up since it successfully drives important improvements in patient self-care competency.

The research establishes which groups of patients need educational strategies the most based on their identity traits so teachers can customize their sessions accordingly. An important number of patients exhibited poor initial knowledge and skills which emphasizes the critical requirement for standard insulin self-administration education within regional diabetes programs.

Extended randomized controlled trials with extended follow-up durations need to assess clinical results including blood sugar management performance together with injection-related problems and patient well-being. Research on educational methods for limited literacy groups along with economic investigations of structured educational programs representing cost-effective solutions in resource restricted regions should be conducted.References

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