

Research Article

Factors that Influence Insulin Adherence in Self-Administration and Actions that Could Improve it

Ego-oma Nwogbe Benson¹, Nzubechukwu Tabugbo Okeke², Chigozie Blessing Okeke³

¹ Canterbury Christ Church University, Adult Nursing, United Kingdom

² Cardiff Metropolitan University, United Kingdom

³ School of Nursing, Nnamdi Azikiwe University Teaching Hospital Nnewi, Nigeria

Copyright: © 2016 Nzubechukwu Tabugbo Okeke, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Introduction

Diabetes is a chronic condition which characteristically involves hyperglycaemia; leading to further health risks and organ failure when sufferers' blood sugar levels are inadequately regulated. According to Diabetes UK [1], diabetes is fast-becoming a major public health concern. Not only has it been estimated that 422 million people globally suffer from the condition, but notably, this figure is rising rapidly [2]. Moreover, diabetes is forecast to become the 7th world primary causes of death worldwide by 2030. From a financial perspective, diabetes is also of major concern. Considering the rising number of diabetic diagnosis as well as the economic cost of managing patients' condition using constant insulin treatment; supporting diabetic patients is immensely expensive and poses great problems for national resources and wider society.

As a prime treatment for diabetes, insulin administration has evolved rapidly. It works by improving the body's metabolic control and helps to reduce the development of microvascular complications [3-6]. Additionally various studies show that its early initiation into treatment or the intensified use of insulin therapy has a strong correlation with improved diabetes management [7]. Despite its successes and the achievements of other diabetic treatment options; nevertheless, according to Bailey and Kodack [8], over 65% of all patients still die prematurely from cardiovascular diseases due to insufficient health control. For example, various research findings reveal that a high proportion of patients practice poor adherence; thus obstructing desired control [9]. Additionally studies exploring diabetic patients' adherence to medication measured compliance at 65%; significantly below the World Health Organization's set standard of 80%.

Notably non-compliance with insulin administration guideline can be disastrous as it substantially reduces the effectiveness of diabetic management. To demonstrate for example, several authors stress effective insulin administration as key to ensuring healthy outcomes for diabetic patients; whilst disparaging non-adherence as severely counterproductive [10-12]. Moreover, other studies highlight a positive correlation between improved patient glycaemic-level control and reduced risks of nephropathy, neuropathy, retinopathy and other lifelong health complications, which pose grave consequences on patients' quality of life and life expectancy [13-15].

During my placement in a diabetes community clinic where patients come to discuss their Haemoglobin A1c (HbA1c), blood sugar levels, insulin regime, carbohydrate count and weight gain due to insulin use including the complications of diabetes. Following assessment in the clinic it was noted that some patients administer insulin on a particular site, on lumps and bruises due to insulin

administration thereby causing hypoglycaemia or hyperglycaemia due to inadequate techniques. The nurses always educate patients on insulin technique, site and how to prime needle with 2 units of insulin before administering the prescribed dose. This spurred my interest in this area of research coupled with the fact that I have interest in becoming a diabetic nurse.

As such, this research project intends to critically evaluate the factors which impact insulin adherence within self-administering patients; with the aim of exploring effective methods of increasing and improving adherence. This dissertation will first highlight the search strategy then review and discuss research findings. Moreover, it will also discuss possible implications for this research and practice, then draw conclusions based on the research outcomes.

Research Strategy

For the purposes of this research project, a systematic literature review was conducted. This is because systematic literature reviews are a rigorous and efficient form of methodology which enable the evaluation and synthesis of scientific research Lichtenstein et al. [16,17]. Thus, its benefits lie in its objectivity and capacity to reduce any bias wrongfully incorporated into the study whether during data collection or reporting. This is achieved through extensive, reproducible and reliable literature searches and follows a stipulated pattern of reporting with a clearly defined data inclusion and exclusion criteria. For this study, a computer-based literature search was conducted via electronic literature databases: Google Scholar, Cumulative Index to Nursing and Allied Health (CINHAL), Medline, PsychINFO and Science Direct.

To conduct the systematic literature review the following key terms were utilised for the search: "diabetes", "mellitus", "insulin administration", "self-care", "insulin", "adherence", "medication", "hypoglycaemic agents", "hyperglycaemic agents", "insulin adherence", "compliance", "fears", "treatment", "anti-diabetic agents", "anti-hypoglycaemic agents", "self-management", "self-administration" and "concordance". Notably the Boolean operator 'AND' or 'OR' was utilised to combine terms during the search in order to generate relevant and productive results.

*Corresponding author: Nzubechukwu Tabugbo Okeke, Cardiff Metropolitan University, United Kingdom Tel: +44 (0) 7429400288; E-mail: zubytab@yahoo.com

Received: March 28 2017; Accepted: April 06, 2017; Published: April 10, 2017

Additionally Google was used in order to search for policy documents and national guidelines on insulin administration and adherence. I also carried out additional searches using the bibliographies of relevant articles in order to identify and access more research findings. Markedly this search included reviewed articles from professional journals, research-based literature, non-peer reviewed articles, systematic reviews and several other research studies using both quantitative and qualitative methods. This search was further narrowed to articles published between 2001-2014 in order to secure research relevance and reliability. Moreover, my inclusion and exclusion criteria was also used to screen emergent articles as noted by Aveyard [18]. The articles included within this study again centred on those published between 2001 and 2014, those published in the English language and those which discussed challenges to insulin regime adherence amongst self-administering patients; or at least contained information pertaining to the topic of this study. The result of this search produced 340 journals: 80 from CINHAL, 123 from Google Scholar, 87 articles from Medline whilst PsychINFO generated 50 articles.

However, some of these articles were later excluded due to the terms stated within the criteria; or because despite their discussion on non-adherence to insulin regimens, nevertheless failed to explore barriers to effective insulin use. I also screened the abstract sections of each article in order to ensure eligibility; and a total of ten articles were selected based on their inclusion criteria and relevance. Following this comprehensive process, 15 articles were selected, analysed and reviewed to produce the findings for the results. These findings were then categorised based on themes which were as follows: insulin administration, interference with lifestyle, perceived personal failure and complex regimens and side effects.

Literature Review

Non-adherence to insulin prescriptions amongst self-care diabetic patients is a key issue mitigating against the effectiveness of strict glycaemic control [19]. As earlier mentioned, strict adherence to insulin regimens are both cost-effective and preventative against the development of diabetes-related nephropathy and neuropathy diseases [20,21]. Markedly these themes has been identified as factors that influence patients' adherence to insulin regimens.

- Insulin delivery devices,
- Treatment complexity and lifestyle,
- Understanding drug-related side effects and knowledge
- Belief or perceived value of treatment
- Patients' knowledge and understanding of the regimen

Other factors also include adverse effects i.e. hyperglycaemia, the fear of injections and needles, public embarrassment and the inconvenience of using this form of therapy [19,22-24]. Moreover, Davies et al. [25] listed weight gain, loss of self-control over life and personal failure as important barriers. Evidence also reveals that patients who suffer from depression show significantly poor adherence to medical regimens when compared to non-depressed patients [26]. In light of this therefore, nurses are paramount in providing care to diabetes sufferers and advancing in their long-term behaviour towards adherence and self-care to treatment regimens.

Insulin delivery device

In Cheen et al. [9] study, adherence was compared amongst patients using premixed insulin in either a prefilled pen or a vial/syringe in order to recognise possible adherence/non-adherence. This retrospective study was carried out on 955 participants visiting a healthcare institution in Singapore; and findings shows that patients using the prefilled pen were more adherent to the insulin regime as opposed to those using the vial/syringe. Additionally Cheen et al [9]. found that lacking financial subsidies from the government served to

exacerbate the distinction and predict adherence significantly.

In light of this therefore, the typology of insulin devices used within treatment administration can majorly affect patients' willingness to adhere to insulin regimes. In this case, the prefilled pen was reported as more satisfactory and preferential to patients than the use of vials/syringes. This distinction was attributed to the fact that the prefilled pen was not only more efficient in providing greater accuracy for doses, it also produced less episodes of hyperglycaemia and better control for the disease.

Cheen et al. [9] study therefore provides an insight into a key factor which can massively impact patient adherence. Nevertheless, the study is not without certain limitations i.e. its dependence on retrospective databases from a single healthcare facility in one area of Singapore; which collectively makes the sample size ungeneralizable, even to fellow Singapore citizens as well as to wider societies. In this way therefore, the data appears isolated and less reliable. Moreover, the use of prefilled electronic data fails to provide an assurance that the patient actually consumed the medication and their subsequent health results directly from the medication style.

Despite these weaknesses however, other studies also support Cheen's notion of the delivery device as an important factor. Markedly, Buysman et al. [27] and Lee et al. [4] all showed that insulin adherence was greater with pen delivery as opposed to vials/syringes. Although it is worth noting that Pawaskar et al. [28] revealed no difference amongst the same population. Nevertheless, Buysman et al. [27] observed that the chances of insulin treatment discontinuation amongst patients using the pen was distinctly less when compared to their vials and syringe counterparts. Moreover, the switching of patients' insulin delivery device from vial/syringe to the use of the pen produced improvements in the medication possession ratio by 13-22% [29]. Whilst an identical research by Pawaskar et al. [28] noted patients switching from vials/syringes scheme to the pen typology did not produce a comparative percentage in adherence to those already on the pen scheme; nevertheless, it produced a slight improvement in patient adherence. As these findings therefore show, patients are more likely to witness improvements in adherence following a switch from the use of vials/syringes to the use of pen delivery. Molife et al., Asche et al. and Rakel [7,30,31] studies all follow this trend.

Nonetheless despite this research support and comparative analysis, nevertheless the findings possess clinical and policy implications due to the wide gap between the follow-up consultations (2weeks-5 years) which can distort data due to participant mortality or other unforeseeable circumstances. Moreover, the subjective methodology of patients' reactions to is open to bias, inaccuracies and manipulation.

Treatment Complexity and Lifestyle

Farsaei et al. [12] investigated adherence to insulin therapy among patients with diabetes to find out the fundamental issues affecting omission of injection amongst patient with type 1 and type 2 diabetes. A cross sectional approach was used in this study and it involved 507 patients with diabetes and injection associated with insulin barriers were assessed. The result showed that there was better compliance among patients with type 1 when compared to type 2. The reasons given for non-compliance are that the insulin injection interfere with their normal meal plans and daily activities. In addition, it was found that most of them feel embarrassed with insulin injection, time consuming, insulin shortage, medication cost, fear of negative effect on their health, forgetfulness, sick days, feeling worse after injection, experience of hypoglycaemia, difficulty in preparation of injection, fear of weight gain and multiple daily injections was noted as key contributors for injection omission. Large sample size was used for this study which was appropriate, however the more adherent patients might have shown interest in taking part in the study as such they

might have perceived themselves as more adherent and this could limit the divergent views which would probably have emerged with diverse sample population. The measurement data used was based on insulin refill data and this does not reflect actual volume used which could also serve as a source of bias.

Effective control and management of diabetes require basic changes in behaviour, which will enable the patient to adhere to complicated regimen and achieve the set goals [32]. The impact could assume two different forms either by the outcome on quality of life or through problems associated with it and stigma. Toljamo and Hentinen [32] explored the factors which are linked to self-care and control of glycaemic amongst individuals with insulin-dependent. 213 people carried out the study using a self-report questionnaire and a biochemical indicator was used for data collection (glycosylated haemoglobin) and the data collection was based in health institution. The findings showed that the mainstream of participants were able to attain better adherence but expressed challenges with other aspects of their self-care. Part of their issue is based on lifestyle. They include smoking, poor metabolic and loneliness as a result of living alone and this interfered with strict adherence to insulin regimen. This study was carried out following a cross sectional approach that did not allow self-care follow up and other issues related with non-adherence on regular basis, which could have been done a lot better with a longitudinal approach [32]. In addition, the assessment of adherence was based on self-report which are subjective though usually used in studies but could be biased as it does not often times reflect the actual situation. However, the finding supported the previous findings, which have noted that lifestyles could influence negatively on adherence to insulin regimen, and suggested modification of regimen to suite individual's lifestyle and provision of supports to ensure better adherence [12,33]. Scaramuzza et al. [33] view was that other unhealthy behaviour could interfere with strict adherence such as smoking and drinking. Complexity of regimen could as well be a problem.

In more complicated cases of diabetes, incorporation of more complex regimen is always the option. Incorporation of multiple drugs to form complex regimen for the management of diabetes has also been identified as a factor, which contributes to non-adherence among individuals (self-cared) with diabetes [14]. Peyrot et al. [24] reiterated this idea in their study noting that complicated insulin regimen places a lot of demands on the patient's ability to integrate the complex regimen in their lifestyles, and that it requires good knowledge level and skills to be able to achieve good adherence. Peyrot et al. [24] by using internet based survey 502 patients in USA including those who have either Type 1 or Type 2 diabetes, explored frequency omission of insulin, the associated factors and regression was used to analyse the data. The result showed that education, lower income, older age, poor diet adherence in type 2 diabetes, interference with daily activities, pain, more frequently prescribed injections, and discomfort as autonomous predisposing factors for deliberate insulin omission. Fifty per cent acknowledged omitting medication while 20% omit insulin injections regularly. Other factors associated with intentional non-adherent to insulin therapy is linked to difficulty with fitting injections around their daily lives, planning days around injection, dissatisfaction with pain involved with injection and the associated embarrassment in the public places. The sample size of this study is small and the participants were self-selected to warrant the generalizability of the pervasiveness of intentional insulin dose omission. Apart from personal factors, perceived fear could be an issue.

Understanding Drug Related Side Effects and Knowledge

The side effects associated with the use of insulin therapy also was identified as having negative impact on the willingness of self-cared individuals with diabetes to adhering with their regimen [14]. In addition, Injection into Lipodystrophy tissues could lead to

bleeding, bruises, mal absorption and inconsistent control of glucose [34]. However, the risk of hypoglycaemia remains a big concern in adherence to insulin regimen for self-administered patients. The side effect and discomforts associated with poor insulin injection technique was reported as a cardinal reason highlighted in non-adherences among self-managed patients [35]. Strauss et al. [36] also surveyed the technique used for insulin injection using 1002 participants who have type 1 and type 2 diabetes among seven countries in Europe. 171 centres was used for data collection which took place in 16 countries, the injection techniques were assessed, the frequency of rotation of injection site, needle length, incidence of lipohypertrophy, use of lifted skin fold and timing of injection. The findings showed that poor injection of insulin could lead to poor absorption in the body and which will in turn cause problems like hypoglycaemia or delayed absorption and this could discourage patients from adhering to prescribed regimen. Though the findings provided evidence which is relevant to practice, the study did not state whether the participants were provided trainings prior to the study or their level of knowledge in regards to insulin injection.

The data from the UK survey on the injection Technique Questionnaire survey carried out with individuals living with diabetes who use insulin [37]. The result showed that despite the advancement of technology in the past 10 years, 45% of patients experienced bleeding or bruises, 17% used incorrect technique, 52% used needle longer than 6mm, 28% admitted injecting into wrong area of lipohypertrophy, 43% were releasing the skinfold too early and 60% used wrong needle size. An evaluation of their education and training showed that most of them have forgotten what they were taught while others could not remember important topics covered. The complexity of injection procedures also hampers adherence as such current procedures should make effort in simplifying the procedure to enable patient's clearer understanding [37]. Though the study acknowledged that the participants were provided training on how to carry out insulin injection and they forgot the information, however nothing was mentioned about their mental state, their cognitive ability and presence of other disease condition which could have impacted their cognition negatively.

According to Casciano et al. [38] who carried out a quantitative study to assess patient's barrier to insulin use. The injection experience is one of the barriers identified in a survey carried out with 11,883 individuals with type 2 diabetes. The findings revealed that patient who received training on insulin administration were less concerned on the route of administration while three per cent of the participants who are experienced on insulin use rated administration route as a source of concern. Moreover, the presence of side effect, difficulty with the maintenance of blood sugar level and fear of hypoglycaemia were more important factors with adherence than naivety of patients to insulin use [23]. The perceived lack of capacity (self-efficacy) to handle the demand diabetes could influence the willingness to adhere to regimen.

Belief or Perceived Value of Treatment

Polonski et al. [39] investigated attitudinal issues linked with insulin adherence amongst individuals with type 2 diabetes. The study adopted a quantitative approach which was carried out using a questionnaire which was completed by 1267 people living with type 2 diabetes and returned. The evidence revealed that negative belief about insulin as a psychological factor enhances insulin non adherence among individuals with type 2 diabetes. Their negative attitude was based on the belief that the use of insulin will be permanent, it comes with life restrictions, recurring issues of hypoglycaemia, personal failure and low self-esteem. However, the most pronounced experience for them are personal failure, anticipated pain, low self-efficacy and lack of fairness. The findings of this study was collated based on a single self-report questionnaire which reflected beliefs and expectation which is

limited in that experiences are better captured through oral interview and also not the actual behaviour and this could serve as a source of bias. Less than half of the questionnaire was returned and this could mean that it is only people that are self-motivated that participated and this does not show a true representation of the population of individuals with type 2 diabetes. However, Polonski and Jackson [40] also noted that patient may link insulin therapy with sense of personal failure which makes them not to comply with the regimen prescribed by the physician.

Broadbent et al. [41] carried out study with Type 1 or Type 2 diabetes, the result revealed that patients who adhere considerably revealed lower perceptions of the fears of diabetes and higher perceptions of personal control by patients who do not adhere. Other research looked at different countries like US, China, UK, Japan, Spain, France, Turkey and Germany of which 88% out of the participants had Type 2 diabetes and found the following factors as predictive of non-adherence. They include travelling, being too busy, skipping meals, stress or emotional problems and embarrassment from the public on injection use [24]. These factors were also reiterated by physicians as reasons given by patients for non-adherence. There was however little consistency with referring these factors as based on the patients perception of the barriers to adherence. Further study which attempted to explore from the psychological factors which fosters non adherence to insulin therapy among self-administered patients with type 2 diabetes highlighted some issues [39]. They include negative beliefs about insulin therapy (especially among people with type 2 diabetes), the risk of potential side effects, e.g. hypoglycaemia and how all these are going to affect their daily lives.

Notwithstanding the evidence that people with previous experience of insulin show fewer concerns with insulin therapy [42], individuals with diabetes still show some issues with adherence to insulin regimen [24]. A survey carried among those with type 1 and type 2 diabetes revealed that 33.2% omitted their insulin doses or did not adhere to prescription, while physicians reported that 75.2% of their patients did not adhere strictly to the prescribed insulin regimen [24]. Several other factors were also highlighted as contributory to non-adherence to insulin regimen among self-administered patients. They are as follows; difficulty in fitting insulin injections around individual's daily routines is always a key issue in adherence to insulin regimen when referring to self-managed patients. Another issue is the rigidity of the insulin regimen and the requirement that the basal injections should be administered at the same time daily are critical sources of non-adherence. Moreover, evidence showed that the fear of weight gain among patients is one of the reason they omit their insulin doses [43].

Patients' Knowledge and Understanding of the Regimen

Moreover study that explored the impact of the awareness of hypoglycaemia on individuals with type 1 diabetes establish that patient who are more aware of hypoglycaemia were more adherent to the recommendation of the physicians on insulin use than those individuals without awareness [44]. It was also noted that individuals who have had referrals to psychiatrist or behavioural change therapy showed more adherence than those without such previous experience. The most popular purpose reported for discontinuation of insulin therapy by studies was advice from physician against insulin use. Research which explored the implication of effective communication among the healthcare professionals and the patients in terms of shared decision making, trust, respect or good understanding of treatment options, found poor communication as a core factor impacting adherence to regimens [45]. In addition, other reasons given were that individuals believed that their diabetes was under control without insulin therapy or did not like injections based on the fact that they use other methods to control their diabetes. In a study carried out to understand non adherence among low income type 2 diabetic patients

who switched from oral hypoglycaemic agent to insulin in Mexico [46]. The result revealed that support from a diabetic nurse predicted positive adherence.

Discussion

As shown in this research project, patient adherence to strict insulin regimes and treatment administration is immensely important. Not only does this systematic treatment produce improved diabetes management and ensure effective glycaemic control; it also reduces the cost of patient care and diabetes management [19].

Markedly the most common factors affecting self-administering patients' adherence is: the complexity of the insulin regime, dosing frequency (greater than once a day), remembering doses and refills, depressions and the fear associated with its side effects [47]. The use of insulin is associated with several problems including education; follow up with patients and monitoring, fear of needles, and regimen complexity. Moreover, patients who suffer from diabetes often use several other medications to help treat or prevent other associated illnesses and the combinations of greater number medications result in increased regimen complexity and may lead to non-adherence [25]. This poses a huge challenge for healthcare professionals managing diabetes cases and nurse educators. The multidisciplinary team need to take these factors into consideration in bid to enhance adherence among diabetic patients. Several studies have mentioned complexity of insulin regimen as a factor contributing to non-adherence [48-50] whilst Cheen et al. [9] observed no significant relationship. The later finding based their argument on lack of clear definition on number of medication that could be referred to as complex. However, complexity of regimen possesses a challenge with fitting it around daily life and remembering the right doses for people with diabetes [11].

Apart from the prescription of insulin regimen, provision of basic education on medication on effective insulin use is crucial [51]. Therefore the healthcare team should assess the patient to find out factors which could interfere with strict insulin adherence and make necessary provision or plan on how to avert such barriers Lee et al. [4]. NICE [52] stated that a structured training should be provided to specialised team appropriate for the management of continuous subcutaneous insulin infusion as well as advice on diet, lifestyle and exercise. An interesting observation made was that patients who were supported and managed by endocrinologist appeared to be more compliant with their insulin therapy not minding the device they are using [19]. This could be explained based on the fact that endocrinologists are supported by the team of multidisciplinary health care staff which help in bringing about a comprehensive care for people with diabetes. This team is made up of podiatric physician, dietician and nurse educator. The contributions from such team have been found to be very critical in the improving patient outcome and adherence to insulin therapy [53] and the need for the involvement of multidisciplinary team was also reiterated in WHO [2] report. However, Nau [53] assertion is not always the case in real practice and may only apply to his sample population.

Finding from studies have noted inaccurate injection technique and its associated effects as an issue contributing to non-adherence [36, 37]. Poor insulin injection technique could lead to poor insulin absorption [35] which may result in immediate hypoglycaemia or delayed absorption [36] and over time could lead to the development of lipohypertrophy. Vardar and Kizilci [34] noted that insulin injection into such areas can result in bruises, bleeding, variable absorption and erratic glycaemic control. Frid et al. [37] noted in their survey that despite the fact that the patients were trained on the appropriate insulin injection technique, they could not recall important aspects of the training and this is because they have not retained the information given to them. However, other reasons why people with diabetes forget their training information could be associated with emotional

factors which might ensue with the diagnosis and performance of the first self-injection as such beclouding their memory [35]. This might be further intensified for those with type 1 with fear of hypoglycaemia, anticipation of pain and feeling unwell while those with type 2 diabetes might be experiencing feeling of personal failure or concern about the associated side effect from insulin use like weight gain and intermittent hypoglycaemia [54].

For these reason, the healthcare professional need to review and simplify the procedure for insulin injection to enable the individuals to go through the process without anxiety. This could be achieved through the use of auto insulin pen [9] and more import for older adult, the inclusion of oral hypoglycaemic agents [55]. In addition, the insulin injection technique need to be revisited to ensure that self-cared insulin users are provided with the necessary information and training and refresher courses to encourage continuing accurate practices and better adherence [37]. However efforts should also be made to monitor the self-cared individuals to ensure that they are making sure this information are used and in accurate way. Pledger et al. [35] have also suggested systemic alternation of site of insulin injection as a way of reducing the risk of developing lipohypertrophy and intermittent check of the injection site by the healthcare professionals as routine part of care.

Notwithstanding the fact that strict adherence to insulin use produces effective glycaemic control which reduces the risk of developing diabetic associated complications [11, 56, 57] Some of the individuals with diabetes find it difficult to meet their glycaemic targets [6]. Other evidences have noted that non-adherence is a big problem facing effective management of diabetes [24, 58]. In other to improve diabetes management especially for the self-cared individuals, effort should be geared toward tackling the concerns, people with diabetes and healthcare professional expressed regarding insulin use [59]. American Diabetic Association acknowledged that diabetics education as an essential component for effective management of type 2 diabetes while NICE [52] advocated for the provision of self-management education from the point of diagnosis. Education based interventions for self-management of diabetes have being the main focus of healthcare professionals and have been promoted as means for acquiring the needed skill for effective management of daily life for individual with type 2 diabetes [59-61]. This is believed to ensure concordance in practice and improvement of staff skills and individuals managing diabetes, improve adherence and overall patient outcome.

For individual with type 1 diabetes who are exclusively dependent on exogenous insulin, the current standard of care is multiple injection therapy [62]. Despite the effectiveness of the use of complex treatment which involves mixture of multiple injections, it places a significant burden on the individuals living with diabetes in terms of skills, knowledge and ability to integrate such regimen with their daily lifestyles [24]. People living with diabetes have highlighted their main concerns as the risk of potential side effect, particularly hypoglycaemia and its impact on their daily life [22, 43]. The negative effect of hypoglycaemia has a significant impact on the health and wellbeing of people with diabetes [11, 63]. The treatment focus for diabetes is mainly to prevent severe hypoglycaemia but evidence also showed that even minor hypoglycaemic episodes places a significant burden causing people with diabetes to adopt several behavioural and lifestyle changes [64].

Another concern for people with diabetes is the issue of the feeling of personal failure. This concern hinges on the permanent use of insulin therapy and the feeling that they have managed their conditions poorly. The complexity of the treatment regimen and fitting around the multiple insulin injections into their normal daily life coupled with fear of injection and the associated discomfort and the need to effectively monitor the blood sugar level were highlighted in other

studies [22, 24]. Kunt and Snoek [43] explained that the thought that once insulin is initiated, the individual with diabetes will continue with insulin for life is the major cause of the feeling of personal failure. The negative feeling of the permanence of insulin therapy have been shown to negatively impact adherence to insulin regimen, therefore, there is need for healthcare professionals managing such individuals to provide them with the necessary psychosocial supports to help them cope with such feeling. Bernard et al. [80] acknowledged the need for psychosocial intervention for people with diabetes but the noted that there lack of experts in psychological support. However, they suggested that healthcare professionals should be provided training to bridge this gap.

The need for strict adherence to insulin regimen as the best approach for effective self-management for people with diabetes cannot be over emphasised. Meece [65] has pointed out that the principal approach to improving adherence to insulin regimen is through effective communication between the healthcare professionals and the individual with diabetes concerning their insulin regimen and the administration procedure. There is need for reconsideration of the challenges and benefit associated with different regimen and their negative and positive impact on individual's lifestyle should also be evaluated [11]. This should be done through open discussion with the healthcare professionals concerning the barriers and fears which insulin therapy poses on their daily life. Such communication will be helpful in dissipating the already existing fears especially those regarding to the efficacy of insulin therapy, the pain, side effects and the different injection devices [66,67].

Khunti et al. [59] reiterated that the participation of people with diabetes in shared decision making process on the insulin regimen and choices of insulin devices will be very useful in improving their adherence to insulin regimen. This makes them feel involved, take ownership and control of their treatment. Effective communication has been shown to be associated with better medication adherence [19]. It is also essential to understand the factors which could communication across patient population like ethnic differences, limited knowledge of health [68], limited proficiency in English [69], poor patient engagement [70] and numerical ability [71]. It is crucial that interventions should address the following factors in the bid to improve adherence to insulin regimen.

The findings of the review showed that many of the people with diabetes express fear of weight gain as part of the issues associated with non-adherence. Dromgoole [11] have explained that weight gain may occur after initiation of insulin therapy particularly for those who eat to prevent the occurrence of low blood sugar when insulin therapy is intensified. The loss of glucose through urine for individuals with diabetes could make them feel hungrier because not all the food eaten gets to be used as energy to nourish the cells. So when insulin therapy is intensified, there is sufficient insulin in the blood to convert glucose to energy. The food eaten are no longer being excreted through urine, this could exacerbate the weight gain if there is no change in diet [11, 72]. In a situation where an individual expresses fear of weight gain, Funnell [67] advised that services of a dietician should be employed to help them with planning of their diet and the individual also has to adhere for effective weight control.

Moreover the fear of hypoglycaemia has remained a substantial issue in improving adherence. It is therefore critical for healthcare professionals to discuss with them their concerns with hypoglycaemia with the aim of finding a better approach to averting such experiences. This could be achieved through creating rapport for the individual with diabetes to express their feelings, and based on this their psychosocial need will be determined Barnard et al. [80]. Evidence has shown that individuals with diabetes are afraid of experiencing hypoglycaemia as well as the associated complications of diabetes [11, 73], such experiences could lead to anxiety, depression and importantly reduced

quality of life [63]. NHS (2010) stressed that supporting individuals with diabetes to effectively manage their condition through provision of information, education and emotional support could help to prevent the exacerbation of psychological.

To ensure better adherence to insulin regimen, patient communication strategies must be carefully developed for diabetes self-management to be appropriate across cultures, accessible languages as well as literacy and numeracy level [74]. Having good literacy skill does not necessarily mean good numeracy skill; this applies to both the individual with diabetes and the nurses. Therefore making an assessment of the literacy and numeracy level of the individual with diabetes prior to the commencement of educational intervention is of necessity. Structured educational programme should be provided and coaching to support long-term independence. According to Attridge et al. [75] patients should be empowered with information and education regarding their diabetes and available treatments to better manage their daily lives. Moreover, such intervention will be effective in reducing the barriers that can impede insulin adherence like perceived burden of the disease, insulin injection side effect and perceived personal failure [74-84]. There is need for the healthcare professionals to work together with individual with diabetes in choosing the most appropriate treatment option.

Conclusion

In conclusion, the problems associated with non-adherence to insulin regimen among self-managed patients appear very complicated. These includes the conflict on what an ideal regimen should be for people living with diabetes and what could be the preferred regimen by the healthcare professional, the challenges with making several lifestyle changes to suit their regimen and the lack of needed skills and knowledge on the part of the patient and the necessary support for the patients from the multidisciplinary healthcare team to make it easier for them. Other individualised factors includes being too busy, travelling, skipping of meals, forgetfulness, having too many injections, fear of injections, fear of putting on weight, having complex regimen, stress or emotional problems and feel of embarrassment when having to inject in the public and need for lifestyle changes. A careful understanding of the above mentioned factors will be very useful in developing an effective regimen tailored to suit individuals need and such possess the capacity for fostering adherence to insulin regimen and in ensuring improved health outcomes.

References

1. Diabetes in the UK: Key statistics on diabetes. UK: Diabetes UK. [Crossref]
2. World health organization (2014) World health organization (2016). Global report on diabetes. Geneva: World Health Organization. [Crossref]
3. Sakthong P, Chabunthom R, Charoenvisuthiwongs R (2009) Psychometric Properties of the Thai Version of the 8-item Morisky Medication Adherence Scale in Patients with Type 2 Diabetes: *The Annals Pharmacotherapy* 43: 950-957.
4. Lee ACH, Bandelow S, Schwarzbauer C, Henson RNA, Graham KS (2006) Perirhinal cortex activity during visual object discrimination: An event-related fMRI study. *NeuroImage* 33: 362-373.
5. Atkinson M, Wilkin A, Stott A, Kinder K (2001) Multi-Agency Working: an Audit of Activity (LGA Research Report 17). Slough: NFER.
6. Dale J, Martin S, Gadsby R (2010) Insulin initiation in primary care for patients with type 2 diabetes: 3-year follow-up study. *Prim Care Diabetes* 4: 85-89. [Crossref]
7. Asche CV, Shane-McWhorter L, Raparla S (2010) Health economics and compliance of vials/syringes versus pen devices: a review of the evidence. *Diabetes Technol Ther* 12: S101-S108.
8. Bailey CJ, Kodack M (2011) Patient adherence to medication requirements for therapy of type 2 diabetes. *Int J Clin Pract* 65: 314-322. [Crossref]
9. Cheen HH, Lim SH, Huang MC, Bee YM, Wee HL (2014) Adherence to

premixed insulin in a pre-filled pen compared with a vial/syringe in people with diabetes in Singapore. *Clin Ther* 36: 1043-1053. [Crossref]

10. Kjeldsen LJ, Bjerrum L, Dam P, Larsen BO, Rossing C, et al. (2015) Safe and effective use of medicines for patients with type 2 diabetes - A randomized controlled trial of two interventions delivered by local pharmacies. *Res Social Adm Pharm* 11: 47-62.
11. Dromgoole P (2014) Supporting people with diabetes to engage with insulin therapy. *Journal of Diabetes Nursing* 18: 378-384.
12. Farsaei S, Karimzadeh I, Elyasi S, Hatamkhani S, Khalili H (2014) Glycemic control in the infectious diseases ward; role of clinical pharmacist interventions. *J Infect Dev Ctries* 8: 480-489. [Crossref]
13. Anderson EJ, Richardson M, Castle G, Cercone S, Delahanty L, et al. (1993) Nutrition interventions for intensive therapy in the Diabetes Control and Complications Trial. The DCCT Research Group. *J Am Diet Assoc* 93: 768-772.
14. Ohkubo Y, Kishikawa H, Araki E, Miyata T, Isami S, et al. (1995) Intensive insulin therapy prevents the progression of diabetic microvascular complications in Japanese patients with non-insulin-dependent diabetes mellitus: a randomized prospective 6-year study. *Diabetes Res Clin Pract* 28: 103-117.
15. Mashitani T, Hayashino Y, Okamura S, et al. (2013) Patient-reported adherence to insulin regimen is associated with glycemic control among Japanese patients with type 2 diabetes: Diabetes Distress and Care Registry at Tenri (DDCRT 3). *Diabetes Res Clin Pract* 100: 189-194.
16. Lichtenstein AH, Yetley EA, Lau J (2008) Application of systematic review methodology to the field of nutrition. *J Nutr* 138: 2297-2306. [Crossref]
17. Oxman AD, Guyatt GH (1993) The science of reviewing research. *Ann N Y Acad Sci* 703: 125-133. [Crossref]
18. Aveyard, Helen (2014) *Doing a Literature Review in Health and Social Care: A Practical Guide*, 3rd edn. New York: open University press.
19. Odegard PS, Capoccia K (2007) Medication Taking and Diabetes: A Systematic Review of the Literature. *Diabetes Education* 33: 1014-1129.
20. Lerman I (2005) Adherence to treatment: the key for avoiding long-term complications of diabetes. *Arch Med Res* 36: 300-306. [Crossref]
21. Asante E (2013) Interventions to promote treatment adherence in type 2 diabetes mellitus. *British Journal of Community Nursing*, Vol 18, No 6.
22. Polonsky WH, Fisher L, Guzman S, Villa-Caballero L, Edelman SV (2005) Psychological insulin resistance in patients with type 2 diabetes: the scope of the problem. *Diabetes Care* 28: 2543-2545. [Crossref]
23. Polonsky WH (2002) Emotional and quality-of-life aspects of diabetes management. *Curr Diab Rep* 2: 153-159. [Crossref]
24. Peyrot M, Barnett AH, Meneghini LF, Schumm-Draeger PM (2012) Insulin adherence behaviours and barriers in the multinational Global Attitudes of Patients and Physicians in Insulin Therapy study. *Diabet Med* 29: 682-689.
25. Davies M, Heller S, Sreenan S, Sapin H, Adetunji O, et al. (2013) Once-weekly exenatide versus once- or twice-daily insulin detemir: randomized, open-label, clinical trial of efficacy and safety in patients with type 2 diabetes treated with metformin alone or in combination with sulfonylureas. *Diabetes Care* 36: 1368-1376. [Crossref]
26. Odegard PS, Gray SL (2008) Barriers to medication adherence in poorly controlled diabetes mellitus. *Diabetes Educ* 34: 692-697. [Crossref]
27. Buysman E, Conner C, Aagren M, Bouchard J, Liu F (2011) Adherence and persistence to a regimen of basal insulin in a pre-filled pen compared to vial/syringe in insulin-naïve patients with type 2 diabetes. *Curr Med Res Opin* 27: 1709-1717. [Crossref]
28. Pawaskar MD, Anderson RT, Balkrishnan R (2007) Self-reported predictors of depressive symptomatology in an elderly population with type 2 diabetes mellitus: a prospective cohort study. *Health and Quality of Life Outcomes* 5: 50.
29. Baser O, Bouchard J, DeLuzio T, Henk H, Aagren M (2010) Assessment of adherence and healthcare costs of insulin device (FlexPen) versus conventional vial/syringe. *Adv Ther* 27: 94-104. [Crossref]
30. Molife C, Lee LJ, Shi L, Sawhney M, Lenox SM, et al. (2009) Assessment of Patient-Reported Outcomes of Insulin Pen Devices Versus Conventional Vial and Syringe. *Diabetes Technology & Therapeutics* 11: 529-538.

31. Rakek RE (2009) Improving patient acceptance and adherence in diabetes management: a focus on insulin therapy. *Adv Ther* 26: 838-846. [\[crossref\]](#)
32. Toljamo M, Hentinen M (2001) Adherence to self-care and social support. *J Clin Nurs* 10: 618-627. [\[crossref\]](#)
33. Scaramuzza A, De Palma A, Mamelì C, Spiri D, Santoro L, et al. (2010) Adolescents with type 1 diabetes and risky behaviour. *Acta Paediatr* 99: 1237-1241.
34. Vardar B, Kizilci S (2007) Incidence of lipohypertrophy in diabetic patients and a study of influencing factors. *Diabetes Res Clin Pract* 77: 231-236. [\[crossref\]](#)
35. Pledger J, Hicks D, Kirkland F, Down S (2012) Importance of Injection Technique in diabetes. *Journal of Diabetes Nursing* 16: 160-165.
36. Strauss K, De Gols H, Hannet I, Partanen TM, Frid A, et al. (2002) A pan-European epidemiologic study of injectable therapy injection technique in patients with diabetes. *Practical Diabetes International* 19: 71-76.
37. Frid A, Hirsch L, Gaspar R, Hicks D, Kreugel G, et al. (2010) Scientific Advisory Board for the Third Injection Technique Workshop.; Scientific Advisory Board for the Third Injection Technique Workshop. New injection recommendations for patients with diabetes. *Diabetes Metab* 36: S3-S18.
38. Casciano R, Malangone E, Ramachandran A, Gagliardino JJ (2011) A quantitative assessment of patient barriers to insulin. *Int J Clin Pract* 65: 408-414. [\[crossref\]](#)
39. Polonsky WH, Fisher L, Guzman S, Villa-Caballero L, Edelman SV (2005) Psychological insulin resistance in patients with type 2 diabetes: the scope of the problem. *Diabetes Care* 28: 2543-2545. [\[crossref\]](#)
40. Polonsky WH, Jackson RA (2004) What's So Tough About Taking Insulin? Addressing the Problem of Psychological Insulin Resistance in Type 2 Diabetes. *Clinical Diabetes* 22: 147-150.
41. Broadbent E, Donkin L, Stroh JC (2011) Illness and treatment perceptions are associated with adherence to medications, diet, and exercise in diabetic patients. *Diabetes Care* 34: 338-340. [\[crossref\]](#)
42. Polinski JM, Smith BF, Curtis BH, Seeger JD, Choudhry NK, et al. (2013) Barriers to insulin progression among patients with type 2 diabetes: A systematic review. *Diabetes Educ* 39: 53-65.
43. Kunt T, Snoek FJ (2009) Barriers to insulin initiation and intensification and how to overcome them. *Int J Clin Pract Suppl* : 6-10. [\[crossref\]](#)
44. Smith SM, Fox PT, Miller KL, Glahn DC, Fox PM, et al. (2009) Correspondence of the brain's functional architecture during activation and rest. *Proc Natl Acad Sci* 106:13040-13045.
45. Lyles CR, Sarkar U, Ralston JD, Adler N, Schillinger D, et al. (2013) Patient-provider communication and trust in relation to use of an online patient portal among diabetes patients: The Diabetes and Aging Study. *J Am Med Inform Assoc* 20:1128-1131.
46. Lerman I, Diaz JP, Ibaranguoitia ME, Pérez FJ, Villa AR, et al. (2009) Nonadherence to insulin therapy in low-income, type 2 diabetic patients. *Endocr Pract* 15: 41-46. [\[crossref\]](#)
47. Siminerio L, Kulkarni K, Meece J, Williams A, Cypress M, et al. (2011) Strategies of insulin injection therapy in diabetes self-management. *Diabetes Educ* 37: 1-10.
48. van Bruggen R, Gorter K, Stolk R, Klungel O, Rutten G (2009) Clinical inertia in general practice: widespread and related to the outcome of diabetes care. *Fam Pract* 26: 428-436. [\[crossref\]](#)
49. Grant RW, Devita NG, Singer DE, Meigs JB (2003) Polypharmacy and medication adherence in patients with type 2 diabetes. *Diabetes Care* 26: 1408-1412. [\[crossref\]](#)
50. Hughes E (2004) Diabetes service provision in primary care. *Pract Diab Int* 21: 17.
51. NICE (2011) Diabetes in adults quality standard. Quality statement, 6: Insulin therapy. NICE, London.
52. National Institute for Health and Clinical Excellence (2008) Diabetes in pregnancy: management of diabetes and its complications from pre-conception to the postnatal period. London: NICE.
53. Nau D (2012) Recommendations for improving adherence to type 2 diabetes mellitus therapy – focus on optimizing oral and non-insulin therapies, focus on optimizing oral and non-insulin therapies. *Am J Manag Care* 18: 49-54.
54. Larkin ME, Capasso VA, Chen CL, Mahoney EK, Hazard B, et al. (2008) Measuring psychological insulin resistance: barriers to insulin use. *Diabetes Educ* 34: 511-517. [\[crossref\]](#)
55. Munshi MN, Hayes M, Sternthal A, Ayres D (2009) Use of serum c-peptide level to simplify diabetes treatment regimens in older adults. *Am J Med* 122: 395-397. [\[crossref\]](#)
56. Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, et al. (2000) Association of glycaemia with macrovascular and microvascular complications of Type 2 diabetes: prospective observational study. *British Medical Journal* 321: 405-412.
57. Holman RR, Paul SK, Bethel MA, Matthews DR, Neil HA (2008) 10-year follow-up of intensive glucose control in type 2 diabetes. *N Engl J Med* 359: 1577-1589. [\[crossref\]](#)
58. Donnelly LA, Morris AD, Evans JM; DARTS/MEMO collaboration (2007) Adherence to insulin and its association with glycaemic control in patients with type 2 diabetes. *QJM* 100: 345-350. [\[crossref\]](#)
59. Khunti K, Davies MJ, Kalra S (2013) Self-titration of insulin in the management of people with type 2 diabetes: a practical solution to improve management in primary care. *Diabetes Obes Metab* 15: 690-700. [\[crossref\]](#)
60. Rutten G (2005) Diabetes patient education: time for a new era. *Diabet Med* 22: 671-673. [\[crossref\]](#)
61. National Institute for Clinical Excellence (2003) Guidance on the use of patient-education models for diabetes. Technology Appraisal 60. NICE, London.
62. Inzucchi SE, Bergenstal RM, Buse JB, Diamant M, Ferrannini E, et al. (2012) Management of Hyperglycemia in Type 2 Diabetes: A Patient-Centered Approach Position Statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care* 35: 1364-1379.
63. Williams SA, Pollack MF, Dibonaventure M (2011) Effects of hypoglycemia on health-related quality of life, treatment satisfaction and healthcare resource utilization in patients with type 2 diabetes mellitus. *Diabetes Res Clin Pract* 91: 363-370.
64. Brod M, Christensen T, Thomson TL, Bushnell DM (2011) The impact of non-severe hypoglycaemic events on work productivity and diabetes management. *Value Health* 14: 665-671.
65. Meece J (2006) Dispelling myths and removing barriers about insulin in type 2 diabetes. *Diabetes Educ* 32: 9S-18S. [\[crossref\]](#)
66. Barag SH (2011) Insulin therapy for management of type 2 diabetes mellitus: Strategies for initiation and long-term patient adherence. *J Am Osteopath Assoc* 11: S13-S19.
67. Funnell M (2007) Overcoming barriers to the initiation of insulin therapy. *Clin Diabetes* 25: 36-38.
68. Schillinger D, Andrew B, Frances W, Anita S, John P, et al. (2004) Functional health literacy and the quality of physician-patient communication among diabetes patients. *Patient Education and Counseling* 52: 315-323.
69. Schenker Y, Karter A, Schillinger D (2010) The impact of limited English proficiency and physician language concordance on reports of clinical interactions among patients with Diabetes: the distance Study. Patient Educ Couns, (epub.).
70. Swenson SL, Rose M, Vittinghoff E, Stewart A, Schillinger D, et al. (2008) The Influence of Depressive Symptoms on Clinician-Patient Communication Among Patients With Type 2 Diabetes. *Medical Care* 46: pp 257-265
71. Cavanaugh K, Huizinga MM, Wallston KA, Gebretsadik T, Shintani A, et al. (2008) Association of numeracy and diabetes control. *Annals of Internal Medicine* 148: 737-746.
72. Laville M, Andreelli F (2000) Mechanisms for weight gain during blood glucose normalization. *Diabetes & Metabolism* 26: 42-45.
73. Pramming S, Thorsteinsson B, Bendtson I, Binder C (1991) Symptomatic hypoglycaemia in 411 type 1 diabetic patients. *Diabet Med* 8: 217-222. [\[crossref\]](#)
74. Teft G (2011) The role of numeracy in diabetes care. *Journal of Diabetes Nursing* 15: 268-273.
75. Attridge M, Creamer J, Ramsden M, Cannings-John R, Hawthorne K, et al. (2014) Culturally appropriate health education for people in ethnic minority

- groups with type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews*, Issue 9. Art. No.: CD006424
76. Polinski JM, Smith BF, Curtis BH, Seeger JD, Choudhry NK, et al. (2012) Barriers to insulin progression among patients with type 2 diabetes: A systematic review. *Diabetes Educ* 39: 53-65.
77. Anderson RJ, Freedland KE, Clouse RE, Lustman PJ (2001) The prevalence of comorbid depression in adults with diabetes: a meta-analysis. *Diabetes Care* 24: 1069-1078. [[crossref](#)]
78. Asch DA, Muller RW, Volpp KG (2012) Automated hovering in health care--watching over the 5000 hours. *N Engl J Med* 367: 1-3. [[crossref](#)]
79. Aveyard H (2007) *Doing a Literature Review in Health & Social Care: a practical guide*. Maidenhead: Open University Press.
80. Barnard KD, Peyrot M, Holt RI (2012) Psychosocial support for people with diabetes: past, present and future. *Diabet Med* 29: 1358-1360. [[crossref](#)]
81. Chaturvedi N, Stevens LK, Fuller JH, Lee ET, Lu M, et al. (2001) Risk factors, ethnic differences and mortality associated with lower-extremity gangrene and amputation in diabetes. The WHO multinational study of vascular disease in diabetes. *Diabetologia*, Volume 44, Issue 2 Supplement, pp S65-S71.
82. Davies M, Storms F, Shutler S, Bianchi-Biscay M, Gomis R, et al. (2005) Improvement of glycemic control in subjects with poorly controlled type 2 diabetes: Comparison of two treatment algorithms using insulin glargine. *Diabetes Care* 28: 1282-1288.
83. Gibney MA, Arce CH, Byron KJ, Hirsch LJ (2010) Skin and subcutaneous adipose layer thickness in adults with diabetes at sites used for insulin injections: implications for needle length recommendations. *Curr Med Res Opin* 26: 1519-1530. [[crossref](#)]
84. Lundman BM, Asplund K, Norberg A (1990) Smoking and metabolic control in patients with insulin-dependent diabetes mellitus. *Journal of Internal Medicine* 227: 101-106.