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Review

Examining Factors That Impact Inpatient Management of Diabetes and the Role of Insulin Pen Devices

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ABSTRACT

Insulin administration in the acute care setting is an integral component of inpatient diabetes management. Although some institutions have moved to insulin pen devices, many acute care settings continue to employ the vial and syringe method of insulin administration. The aim of this study was to evaluate the impact of insulin pen implementation in the acute care setting on patients, healthcare workers and health resource utilization.

A review of published literature, including guidelines, was conducted to identify how insulin pen devices in the acute care setting may impact inpatient diabetes management. Previously published studies have revealed that insulin pen devices have the potential to improve inpatient management through better glycemic control, increased adherence and improved self-management education. Furthermore, insulin pen devices may result in cost savings and improved safety for healthcare workers.

There are benefits to the use of insulin pen devices in acute care and, as such, their implementation should be considered.

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R É S U M É

L'administration d'insuline dans les établissements de soins de courte durée fait partie intégrante de la prise en charge du diabète en milieu hospitalier. Bien que certains établissements aient maintenant adopté les stylos à insuline, plusieurs établissements de soins de courte durée continuent d'utiliser la fiole ou la seringue comme mode d'administration de l'insuline. Le but de cette étude était d'évaluer les conséquences de l'introduction des stylos à insuline dans les établissements de soins de courte durée sur les patients, les travailleurs de la santé et l'utilisation des ressources en santé.

Une revue de la littérature existante, dont les lignes directrices, a été menée pour déterminer de quelle manière les stylos à insuline dans les établissements de soins de courte durée peuvent avoir des répercussions sur la prise en charge du diabète en milieu hospitalier. Les études précédemment publiées ont révélé que les stylos à insuline ont le potentiel d'améliorer la prise en charge en milieu hospitalier par le biais d'une meilleure régulation de la glycémie, d'une observance accrue et d'un meilleur enseignement en matière de prise en charge autonome. De plus, les stylos à insuline peuvent entraîner des réductions de coûts et améliorer la sécurité des travailleurs de la santé.

L'utilisation des stylos à insuline comporte des avantages et, de ce fait, leur introduction devrait être considérée.

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Introduction

The prevalence of diabetes is increasing; a predicted 4.2 million people will be living with diabetes by 2020. The cost of diabetes to the Canadian economy was CAN\$11.7 billion in 2010, and if diabetes follows current trends, this number will reach \$16 billion by 2020 (1).

The Canadian Diabetes Association (CDA) estimates that 80% of the costs result from diabetes complications. These complications arise due to poor glycemic control and include microvascular and macrovascular complications, such as chronic kidney disease, retinopathy, neuropathy, stroke, myocardial infarction and death (2).

Diabetes is a common comorbidity in hospitalized patients (3). Canadian practice guidelines support the need to maintain glycemic control in hospitalized patients (4). A diabetes patient whose glycemic control is inadequate during hospitalization may require modifications of their existing diabetes treatment regimens, which may include insulin initiation or intensification (4).

It is imperative that every measure be taken to maintain glycemic control in hospitalized patients, both during their stays and after they are discharged, so as to minimize the risk for complications. One potential intervention to reach this goal is the use of insulin pen devices in both outpatient and inpatient settings.

The insulin pen device has many attributes and was developed with the intention of improving the delivery of the drug and decreasing the burden on the patient. The value of insulin pen use in the outpatient setting has been well defined (5), but a comprehensive evaluation of the impact of using insulin pens in the Canadian acute care setting is lacking. A conservative estimate of 12% to 26% of hospitalized patients have diabetes, and inpatient management of hyperglycemia is complex (6). Thus, outlining detailed protocols and defining the role of insulin pens in the management of inpatient diabetes is essential.

With the prevalence of diabetes increasing and hospitalization serving as 1 potential point of insulin initiation, it has been suggested that the various methods of insulin administration in the inpatient setting should be examined so as to benefit from this unique opportunity (7).

The goals of inpatient diabetes management have been indicated as follows: achieve individual glycemic control, treat any diabetes-related complications, prevent any drug-related adverse events and new complications and, finally, implement education regarding diabetes self-management (8). In addition to the aforementioned goals, reducing the cost of treating diabetes is essential in the current economic climate. This review is meant to evaluate the potential impact of insulin pen devices on the objectives of inpatient management of diabetes.

Glycemic Control and Preventing Insulin-Related Complications

Accurate dosing of insulin is important in achieving glucose targets

The clinical outcomes that contribute to the pharmacoeconomic burden of inpatients with diabetes include hyperglycemia, hypoglycemia, length of stay and diabetes-related complications, such as cardiovascular disease (8). According to recommendations by the CDA, patients with diabetes should strive to reach glucose targets so as to avoid or delay diabetes complications (9). In order to maintain optimal glycemic control, patients should be receiving the most accurate dosages as inpatients and outpatients. Insulin pens have been found to have consistent and accurate dose delivery across a range of doses and within the limits specified by the International Organization for Standardization (10).

A prospective, randomized study compared the use of insulin pen devices and the vial/syringe method of insulin administration

in the hospital setting. Patients who were assigned to the insulin pen group experienced fewer hyper- and hypoglycemic events daily while using insulin pens (11). Although not statistically significant, the results suggest that pens contribute to glycemic control in hospitalized patients.

Insulin pen devices deliver more accurate doses than vials and syringes

One study evaluated the handling and dosing accuracy of insulin pens vs. vials and syringes involving both insulin therapy-naïve and insulin therapy-experienced healthcare professionals (nurses and pharmacists) (12). Insulin therapy-naïve healthcare professionals found that the insulin pen was both easier to hold and more stable during injection ($p < 0.01$). For both groups of healthcare professionals, the insulin pen mean dose delivered was significantly closer to the intended dose of 10 U than the dose delivered via vial and syringe ($p < 0.001$) (12). It should also be noted that the syringe and vial methods demonstrated higher degrees of variation in doses delivered than the insulin pen, as demonstrated by the differences in standard deviation from the mean (12).

A similar study of the performance of healthcare professionals in the United States, including physicians, diabetes nurses and educational and institutional nurses, reported comparable results. The mean absolute deviations of the insulin doses administered by healthcare professionals were significantly reduced when using insulin pens compared to vials and syringes ($p < 0.0001$) across 4 different doses (5 IU, 25 IU, 43 IU, 78 IU) (13).

Injection technique and use of shorter needle length are recommended to ensure optimal insulin delivery

In addition to achieving tight glycemic control through accurate dosing, the depth of injection should also be considered (Figure 1). It has been suggested that injection technique holds significance comparable to that of dose and insulin type in achieving glycemic control (14). For optimal absorption of insulin, injection into the subcutaneous tissue is recommended (15). The speed of insulin diffusion depends on the depth of injection. If insulin is injected too deeply, the rapid diffusion results in a shorter duration of action, and these intramuscular (IM) injections result in a broader variability of absorption (16).

An evaluation of skin thickness and subcutaneous adipose layer thickness by ultrasound was conducted in adult patients with diabetes and with a range of adiposity and diverse demographic characteristics. The mean skin thickness ranged from 1.87 mm in the thigh to 2.41 mm in the buttocks. The mean subcutaneous adipose layer thickness ranged from 10.35 mm in the thigh to 15.45 mm in the buttocks (14). The authors estimated, based on their findings, the percentage of injections that would result in subcutaneous (SC) vs. skin or IM drug delivery. It was estimated that using 5 mm needles, 98% of 90 degree insertions are SC and the remainder IM; 6 mm and 8 mm needles showed that proportionately more injections are IM (>5% and 15%, respectively); and 12.7 mm needles showed that 45% of injections would be IM. The use of a 4 mm needle was estimated to deliver drug SC 99.5% of the time (14). Insulin syringes are available as short as 6 mm, whereas safety pen needles are available at 5 mm, and nonsafety pen needles are available at 4 mm.

Reducing the risk for adverse events related to insulin administration

Nurses administering insulin are at risk for experiencing a needlestick injury

A retrospective study in the United States evaluated needlestick injuries to nurses in diabetes care and found that 313 of 400 (78.3%)

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