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REVIEW

# In-Hospital Management of Hyperglycemia: The Role of Insulin Degludec

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## ABSTRACT

***Introduction*:** Hyperglycemia is a common and challenging condition in hospitalized patients both with and without a history of diabetes. Managing hyperglycemia effectively is critical in reducing complications, mortality, and the length of hospital stays. Insulin degludec (IDeg), an ultralong-acting basal insulin, has a well-established efficacy and safety profile in terms of managing hyperglycemia in outpatients; it has demonstrated benefits in clinical practice across various patient populations. This review aims to assess the evidence on its clinical suitability, as well as efficacy and safety, for managing hyperglycemia across different inpatient populations. The review specifically focuses on outcomes such as glycemic control, glycemic variability, safety (particularly hypoglycemia risk), dosing flexibility, ease of titration, and use in special populations.

***Methods*:** A comprehensive literature search was conducted using PubMed to identify studies published between 2014 and 2024. Eligible studies included randomized controlled trials, real-world evidence, and case series that examined the use of IDeg for hyperglycemia management in hospitalized patients.

***Results*:** The reviewed studies consistently demonstrated that IDeg provides stable and predictable glycemic control with low glycemic variability. The ultralong duration of action, ability to be titrated daily, and flexibility in

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dosing make IDeg suitable for noncritical care settings with difficult-to-maintain rigid insulin schedules. Furthermore, the risk of hypoglycemia, particularly nocturnal hypoglycemia, is low with IDeg. These attributes are beneficial across diverse inpatient populations. Practical advantages, such as ease of administration with a specialized delivery device, further support its use in hospital settings.

***Conclusions*:** Unique pharmacokinetic and pharmacodynamic properties of IDeg, reduced glycemic variability, low hypoglycemia risk, ease of daily titration, and dosing flexibility make it appropriate for managing hyperglycemia in hospitalized patients.

**Keywords:** Basal insulin; In-hospital management; Glycemic variability; On-critical care settings; Insulin dosing flexibility

| Key Summary Points |
| --- |
| Insulin degludec (IDeg) has a well-established efficacy and safety profile in managing hyperglycemia in an outpatient setting and has demonstrated benefit in clinical practice across various patient populations. |
| The review aims to assess the evidence on the suitability of the clinical utility of IDeg in managing hyperglycemia in hospitalized patients, as well as across different inpatient populations. |
| IDeg offers stable, predictable glycemic control with low variability and flexible dosing, thereby being suitable for non-critical care settings. |
| The review specifically focuses on the outcomes of IDeg, such as glycemic control, glycemic variability, safety (particularly hypoglycemia risk), dosing flexibility, ease of titration, and use in special populations in a hospital setting. |

## INTRODUCTION

Inpatient hyperglycemia, defined as blood glucose (BG) levels exceeding 140 mg/dl, is common in both diagnosed and undiagnosed patients with diabetes, presenting significant management challenges [1]. Factors such as inconsistent nutritional intake, reduced mobility, and acute illness complicate maintaining glycemic control [2]. Stress-induced hormonal responses and certain medical treatments, particularly glucocorticoid therapy, further exacerbate hyperglycemia, leading to more severe patient outcomes [2].

The consequences of uncontrolled hyperglycemia are grave, even when diabetes is not the primary reason for hospitalization. It can lead to prolonged hospital stays, increased healthcare costs, higher complication rates, and increased mortality rates [3, 4]. The prevalence of hyperglycemia in hospitalized patients is alarmingly high, ranging from 37.28 to 45.9% [5]. This is particularly critical in certain populations, such as patients with non-ST-segment elevation myocardial infarction (NSTEMI), where hyperglycemia is linked to an in-hospital mortality rate of up to 13% [5]. An Indian study reported that 55.4% of patients with NSTEMI had hyperglycemia on admission [5]. The wide range of the hyperglycemia prevalence among hospitalized patients reflects differences in institutional protocols, patient demographics, clinical practices, and regional standards. This variability underlines the complexity of managing hyperglycemia across diverse settings and necessitates adaptable, evidence-based strategies tailored to specific patient populations. Ensuring that in-hospital management recommendations remain broadly applicable and effective is essential. These findings further emphasize the importance of effective hyperglycemia management strategies to reduce the risk of complications, lower the mortality rate, and improve patient outcomes.

Additionally, the effects of hypoglycemia and glycemic variability are equally concerning. Hypoglycemia, often resulting from improper insulin dosing or poor treatment adjustments, is associated with a 66% increased risk of death

within 1 year and prolongs hospital stays by an average of 2.8 days [6]. High glycemic variability has been shown to independently predict increased mortality, especially in patients with type 2 diabetes mellitus (T2DM) [7]. It is linked to an increased risk of both macrovascular and microvascular complications, as well as higher rates of hypoglycemia [8]. High glycemic variability is associated with an increased risk of developing diabetes-related complications, especially in patients with cardiac conditions [9]. While glycemic variability remains an important factor, some studies suggest that time-in-range (TIR) may be a stronger predictor of outcomes in hospitalized patients [10, 11]. Recognizing the significance of both, a comprehensive approach addressing glycemic variability along with absolute glucose levels is critical for achieving optimal patient outcomes. However, traditional approaches to glycemic control in hospitalized patients often lack the necessary flexibility to adapt to changing patient needs. This rigidity can result in inappropriate dosing and an increased risk of hypoglycemia, especially for patients with fluctuating nutritional intake or those undergoing medical procedures [2].

To mitigate the risks, it is crucial to establish clear glycemic targets for hospitalized patients. Table 1 details glycemic targets for hospitalized patients [1, 26, 69]. Achieving these targets can reduce the risk of complications and improve overall patient outcomes. Various randomized controlled trials (RCTs) and observational studies have demonstrated that improving glycemic control not only reduces the length of hospital stays but also lowers the incidence of systemic infections and both short- and long-term mortality [12–14].

Insulin remains the cornerstone of hyperglycemia management in hospitals, with basal–bolus regimens being the preferred approach. This regimen combines basal insulin, which provides continuous glucose control, with prandial (mealtime) and correction insulin to address postprandial spikes. The American Diabetes Association (ADA) 2025 guidelines recommend a basal insulin or basal plus bolus correction insulin regimen for noncritically ill hospitalized patients with poor oral intake or those with no oral consumption or oral intake restrictions. An insulin regimen with basal, prandial, and correction components is the preferred treatment for most noncritically ill hospitalized patients with adequate nutritional intake. Notably, the use of sliding scale insulin (SSI) without basal insulin is discouraged [1].

**Table 1** Recommended glycemic targets in hospitalized patients

| Guidelines | Patient type | Glycemic goals (mg/dl) |
|---|---|---|
| ADA 2025 (Care D 2025) [1] | Non-ICU setting | 100–180 |
| | Critically ill patients | 140–180[a] |
| | Critically ill patients undergoing surgery | 110–140[b] |
| | Terminally ill individuals with short life expectancy, advanced kidney failure, and/or at high risk of hypoglycemia | ≤ 250 |
| RSSDI 2022 & 2020 | Most critically and noncritically ill patients [26] | 140–180 |
| | Critically ill patients undergoing surgery [69] | 110–140 |

*ADA* American Diabetes Association, *ICU* intensive care unit, *RSSDI* Research Society for the Study of Diabetes in India

[a]Once therapy is initiated, a glycemic goal of 140–180 mg/dl is recommended for most critically ill (ICU) individuals with hyperglycemia

[b]A more stringent glycemic goal may be appropriate for selected individuals if it can be achieved without significant hypoglycemia

Similarly, the Research Society for the Study of Diabetes in India (RSSDI) 2022 guidelines recommend using a basal–bolus regimen for patients undergoing surgery [15].

The preference for a basal–bolus regimen over SSI arises from the historical context, wherein SSI was once the standard practice but proved to be inadequate for stable glucose management. SSI has been associated with increased complications, such as infections and longer hospital stays [16]. In contrast, basal–bolus regimens utilizing long-acting insulin provide more stable and proactive glucose management, thereby reducing glycemic variability and improving overall patient outcomes [17–19]. Multiple RCTs have consistently shown that basal–bolus regimens outperform SSI in terms of glycemic control and reduction of hospital-related complications [20, 21].

Long-acting insulins in a basal–bolus regimen play a vital role in managing hyperglycemia in hospitalized patients by maintaining consistent insulin levels throughout the day, particularly benefiting patients with irregular meal patterns typical in hospital settings. Studies indicate that combining long-acting basal insulin with rapid-acting mealtime insulin not only enhances glycemic control but also reduces complications during hospitalization [17, 18]. Clinical practice guidelines advocate the use of basal and prandial insulin regimens with insulin analogs for most noncritically ill hospitalized patients with diabetes who have adequate nutritional intake [1].

Long-acting insulin analogs, such as insulin glargine (IGlar) U100 and IGlar U300, have demonstrated effectiveness in managing hyperglycemia in hospitalized patients with T2DM, exhibiting low rates of hypoglycemic events across medical and surgical settings [4, 14, 22]. Comparative studies have shown that IGlar provides similar glycemic control while reducing hypoglycemia rates compared with neutral protamine Hagedorn (NPH) and premixed formulations [23, 24].

Similarly, insulin degludec (IDeg) is an ultra-long-acting, new-generation basal insulin. It has been used extensively in clinical settings, with a favorable efficacy and safety profile. Emerging data from recent studies demonstrate IDeg as a promising agent in managing hyperglycemia in hospitalized patients. IDeg has exhibited an efficacy comparable to IGlar U100 in inpatient settings, while maintaining a favorable safety profile [25].

This review aimed to evaluate the use of IDeg as the basal component in basal–bolus regimens for noncritically ill hospitalized patients. While basal–bolus regimens are widely regarded as the most effective for managing hyperglycemia, there is limited research specifically addressing the safety and efficacy of IDeg in this context. Therefore, the objective of this study was to critically assess the available evidence of using IDeg in hospitalized patients.

## METHODS

A comprehensive literature search was conducted at PubMed—an electronic database—to identify studies evaluating the use of IDeg in hospitalized patients. Combinations of search terms were employed to capture relevant studies, such as “Insulin degludec” AND “in-patients,” “Insulin degludec” AND “basal–bolus regimen” AND “hospitalized patients,” “Insulin degludec” AND “hyperglycemia” AND “hospital,” “Insulin degludec” AND “hospitalized patients,” “Insulin degludec in hospitalized patients,” and “Insulin degludec in hospital patients.”

### Inclusion and Exclusion Criteria

The identified studies were included if they met the specific predefined criteria. The population of interest was hospitalized patients, either in general medicine or surgical settings, who were being managed for hyperglycemia. The primary intervention of interest was the use of IDeg in hospitalized patients. Studies published from 2014 to 2024 were included to ensure the relevance of the findings to current clinical practice.

Acceptable study designs included RCTs, real-world evidence, and case series.

Studies focusing on outpatient management or settings, including home or primary care, or with the study population on premix insulin regimens were excluded. Non-human studies, as well as those not addressing the use of IDeg for hyperglycemia management in hospitalized patients, were also excluded.

### Study Selection and Data Extraction

The initial search yielded a broad set of studies. A total of 12 studies were identified after subsequent screening for relevance based on the inclusion and exclusion criteria. Of these, four studies were excluded based on the defined exclusion criteria: two studies involving insulin detemir (IDet) and two on premixed insulin formulations. Consequently, eight studies demonstrating the findings significant to the research focus were included in the final analysis.

For uniformity across the manuscript, BG values originally reported in mmol/l were converted into mg/dl using the standard conversion factor (1 mmol/l = 18 mg/dl), wherever applicable. The selected studies were carefully reviewed to extract data regarding the outcomes of IDeg use in hospitalized patients, focusing on metrics such as glycemic control, glycemic variability, safety, hypoglycemia risk, flexibility in dosing, and ease of titration.

## UNIQUE IDEG PHARMACOKINETIC FEATURES TRANSLATING INTO CLINICAL BENEFITS

In the realm of inpatient diabetes management, the selection of an appropriate basal insulin is pivotal for optimizing glycemic control while minimizing risks such as hypoglycemia and glycemic variability. Choosing a basal insulin with characteristics such as ease of titration, flexible dosing, maintenance of desired glycemic control, and a lower hypoglycemia risk can significantly improve clinical outcomes, especially in complex inpatient settings [26]. Table 2 details the pharmacokinetic (PK) and pharmacodynamic (PD) properties of the existing basal insulins.

IDeg is a basal insulin analog characterized by an ultralong duration of action (beyond 42 h), which significantly enhances its PK profile compared with other basal insulins. An ideal basal insulin should mimic the physiological profile of endogenous insulin secretion, providing a near-constant plasma insulin level over 24 h, predictable glucose-lowering effects, and a low frequency of administration to accommodate individual patient lifestyles [2, 26, 27].

The unique structure of IDeg contributes to its prolonged action. It shares the same amino acid sequence as human insulin but includes modifications such as the removal of threonine at position B30 and the addition of lysine at position B29, linked via a glutamic acid spacer to a 16-carbon fatty diacid. These alterations facilitate the formation of multi-hexamer aggregates in the subcutaneous tissue, allowing a gradual release of insulin monomers into circulation [28]. The maximum concentration ($C_{max}$) can reach up to 4472 pmol/l within 1 h after administration, with an action duration lasting at least 42 h and potentially extending up to 4 days [29].

IDeg exhibits a half-life of over 25 h, making it the only basal insulin with a half-life exceeding its dosing interval. This characteristic allows flexible dosing schedules [30]. The PK profile of IDeg gradually achieves steady-state concentrations characterized by a very low peak-to-trough ratio, minimizing the risk of hypoglycemia associated with peak concentrations [31–34].

## INSULIN DEGLUDEC: TRANSCENDING FROM OUTPATIENT TO INPATIENT USE

Since its approval more than a decade ago, IDeg has firmly established its role in outpatient settings across a wide range of populations. Initially approved for glycemic control in patients aged 1 year and older with diabetes mellitus [35], IDeg has demonstrated remarkable efficacy and safety over the years. Its effectiveness extends across various populations, including pediatric, elderly, and renal/hepatic-impaired patients. The

**Table 2** Clinical and PK/PD aspects of basal insulin

| Attribute | IDeg | IGar U300 | IDet | IGar U100 | Intermediate-acting (NPH insulin) |
|---|---|---|---|---|---|
| Onset of action, hours | 0.5–1.5 h [53] | 2–6 h [53] | 1–2 h [53] | 2–4 h [53] | 1–2 h [72] |
| Elimination (half-life at steady state), hours | 25 h [35] | 18–19 h [55] | 5–7 h [70] | 13.5 h [71] | Apparent half-life ~ 4.4 h [73] |
| Duration of action, hours | More than 42 h [35] | 30–36 [53] | 20–24 [53] | 22–24 [53] | 14 or more hours [72] |
| Median time to maximum serum levels, hours | 9 h (Tresiba PI) | 12–20 h [55] | 6–8 h (Levemir PI US FDA) | 8–12 h [71] | ~ 4 h (Humulin N USPI) |
| Injection timing | Flexible timing (once daily at any time of the day) [35] | Administer at the same time daily [55] | Once daily (evening) or twice daily (morning and evening) [70] | Same time of the day [71] | Customize the dosage and modify it according to the patient's metabolic requirements, blood glucose monitoring findings, and desired glycemic control [73] |
| Use in special populations | | | | | |
| Pediatric | Approved from 1 year of age [35] | Safety and effectiveness have not been established in pediatric patients (under 18 years of age) [55] | Approved [70] | Approved from 2 years of age [71] | Indicated to improve glycemic control [73] |
| Elderly | Caution advised [35] | Caution advised [55] | Greater sensitivity cannot be ruled out [70] | Caution should be exercised [71] | Has not been studied [73] |
| Renal impairment | No clinically relevant PK difference in patients with impairment (versus those without) [35] | Has not been studied [55] | No PK difference in patients with renal impairment (versus those without) [70] | Has not been studied [71] | Has not been studied [73] |

Table 2 continued

| Attribute | IDeg | IGar U300 | IDet | IGar U100 | Intermediate-acting (NPH insulin) |
|---|---|---|---|---|---|
| Hepatic impairment | No PK difference in patients with hepatic impairment (versus those without) [35] | Has not been studied [55] | Lower systemic exposure in patients with severe hepatic impairment (versus those without) [70] | Has not been studied [71] | Has not been studied [73] |

*IDeg* insulin degludec, *IDet* insulin detemir, *IGlar U100* IGlar 100 units/ml, *IGlar U300* IGlar 300 units/ml, *NPH* neutral protamine Hagedorn, *PD* pharmacodynamics, *PK* pharmacokinetic

most recent development has been its approval for use in pregnant women [35].

In pediatric patients (aged ≥ 1 year), IDeg effectively manages glycemic control with tailored dosing strategies that help mitigate the risk of hypoglycemia [35]. A treat-to-target RCT demonstrated that once daily IDeg was noninferior to IDet in children aged 1–17 years with type 1 diabetes. Over 52 weeks (26 weeks [$n = 350$], followed by a 26-week extension [$n = 280$]), IDeg achieved similar glycated hemoglobin (HbA1c) control, with a significant reduction in fasting plasma glucose (FPG) (− 23.22 mg/dl vs. + 19.80 mg/dl for IDet; with an estimated treatment difference of − 29.16 mg/dl [− 2.84; − 0.41] 95% confidence interval [CI], $p = 0.0090$) and required a 30% lower basal insulin dose. Additionally, IDeg-treated patients experienced fewer nocturnal hypoglycemic events and significantly lower rates of hyperglycemia with ketosis, suggesting it to be a suitable option for pediatric diabetes management [36].

In elderly patients (aged ≥ 65 years), IDeg significantly reduced hypoglycemia compared with other long-acting insulins. A meta-analysis revealed that IDeg was associated with a 24% reduction in the overall hypoglycemia and a 36% reduction in nocturnal hypoglycemia compared with IGlar [35, 37]. The post hoc analysis of SWITCH 2 trial demonstrated a 30–43% reduction in severe and symptomatic hypoglycemia across age groups, further supporting these findings [38]. This is particularly important for frail older adults, as hypoglycemia can lead to serious risks such as falls, dementia, and cardiovascular complications [39].

The EXPECT trial in pregnant women with type 1 diabetes mellitus (T1DM) demonstrated that IDeg is noninferior to IDet in terms of safety and efficacy. In 225 pregnant women randomized to IDeg or IDet, HbA1c levels were similar at baseline and before delivery. The estimated treatment difference between the groups was − 0.11%, confirming noninferiority (95% CI − 0.31 to 0.08; − 1.2 mmol/mol [95% CI − 3.4 to 0.9]; $p_{\text{noninferiority}} < 0.0001$), and no additional safety concerns were observed with IDeg [40].

No difference in the pharmacokinetics of IDeg has been observed between healthy subjects and patients with renal or hepatic impairment

[35]. Moreover, IDeg has been associated with improved graft survival and better post-transplant glycemic outcomes in patients undergoing a renal transplant [41].

## CRITICAL EVALUATION OF EVIDENCE

The attributes that make IDeg effective in outpatient care are equally relevant in inpatient settings, where glycemic control is critical. Transitioning from outpatient to inpatient management presents distinct challenges, particularly in maintaining consistent glycemic control amid fluctuating metabolic demands, stress, and changes in nutrition and medications. In this context, the PK properties of IDeg, such as its ultralong duration of action and reduced glycemic variability, make it a promising option for managing hyperglycemia in hospitalized patients.

Several studies have compared IDeg with other basal insulins, such as IGlar, across various inpatient scenarios, from medical and surgical wards to specialized care settings. These studies consistently showed that IDeg provided glycemic control comparable to IGlar while offering advantages in reducing glycemic variability and the risk of hypoglycemia. Table 3 provides an overview of recent evidence of IDeg in the management of hyperglycemia in hospital.

In these studies, a large-scale Indian trial by Kuchay et al. is particularly noteworthy. This prospective, open-label RCT evaluated 239 patients (mean age 61.3 ± 8.1 years) with T2DM undergoing coronary artery bypass graft (CABG). The study compared IDeg U100 with IGlar U300 and found that FPG levels were significantly better with IDeg (140 mg/dl vs. 148 mg/dl, $p = 0.013$). Additionally, a significantly higher percentage of BG readings was within the range of 70–140 mg/dl for patients receiving IDeg than IGlar (43.7% vs. 38.9%, $p < 0.0001$), as well as within the range of 100–140 mg/dl (37.1% vs. 34.4%, $p = 0.027$). Both IDeg U100 and IGlar U300 groups spent a similar percentage of time in the target glucose range and had a comparable time above the target range (> 180 mg/dl) and below the target range (< 70 mg/dl). Importantly, no severe hypoglycemic events were reported in either group, indicating that IDeg U100 is equally safe and effective as IGlar U300 in managing inpatient hyperglycemia in surgical patients [42].

In a large study of 180 medical and surgical inpatients (aged > 18 years) with T2DM, Galindo et al. demonstrated that IDeg and IGlar U100 provided comparable glycemic control. The mean daily BG levels were comparable for both insulins (180.0 ± 37.8 vs. 180.0 ± 45.0 mg/dl, $p = 0.90$), and the proportion of patients with BG within the target range was also similar (54.5% ± 29% for IDeg vs. 55.3% ± 28% for IGlar, $p = 0.85$). Furthermore, there were no significant differences in basal insulin doses, the length of hospital stay, or the rates of hypoglycemia [25]. These findings further confirm that IDeg is as effective as IGlar U100 in managing inpatient hyperglycemia, with a comparable safety profile.

Simioni et al. conducted a retrospective study involving 52 patients (5 with T1DM and 47 with T2DM; mean age: 69.4 ± 16.3 years) with comorbidities such as chronic kidney disease (35%) and peripheral vascular disease (23.1%). The study reported a significant decrease in FPG after just 4 days on IDeg therapy, and to 153 mg/dl at discharge ($p < 0.0001$). The study also noted a reduction in glycemic variability, with the standard deviation (SD) of BG values dropping from 125 to 37.7 mg/dl ($p < 0.0001$) at discharge. No severe hypoglycemia occurred [43]. These findings highlight the rapid glucose-lowering effect of IDeg, which is essential for managing inpatient hyperglycemia. The reduction in glycemic variability is particularly important, as it is associated with improved glycemic control and a reduced risk of complications in hospitalized patients.

In a prospective observational trial involving 65 hospitalized patients with T2DM (mean age: 70.8 ± 10.7 years) who had three or more comorbidities, Ponzani et al. compared the outcomes between patients who switched from traditional basal insulin therapy to either IDeg ($n = 35$) or IGlar U100 ($n = 30$). In the group that switched to IDeg, significant reductions in the mean capillary BG were observed across all time slots from the initiation of therapy to discharge. The

**Table 3** Recent evidence of IDeg in hospital hyperglycemia management

| Study | Study design | Study population | Endpoints | Outcomes |
|---|---|---|---|---|
| Galindo et al., 2022 [25] | Multicenter, prospective, noninferiority, open-label RCT | A total of 180 general medical/surgical patients with BG 140–400 mg/dl at admission<br>On OADs ± insulin (except IDeg/IGlar U300), LOS ≥ 3 days | Primary efficacy endpoint: Noninferiority of IDeg U100 compared with glargine U100, measured by the mean daily BG concentration during the hospital stay<br>Safety endpoints: Hypoglycemia, proportion of BG readings, severe hyperglycemia, insulin dosage, and length of hospital stay<br>Exploratory outcomes: Complications and hospital mortality | Comparable Mean daily BG levels<br>Similar proportion of patients with BG within the target range.<br>No significant differences in basal insulin doses (29.6 ± 13 units/day for IDeg vs. 30.4 ± 18 units/day for IGlar, $p = 0.85$), the length of hospital stay (median [IQR]: 6.7 days for IDeg vs. 7.5 days for IGlar, $p = 0.61$), or the rates of hypoglycemia |
| Kuchay et al., 2023 [42] | Single-center, prospective, open-label RCT | A total of 239 patients with T2DM admitted for CABG<br>Randomized to IDeg U100 or IGlar U300<br>CGM subgroup<br>A subset of patients from the main population underwent CGM to assess detailed glycemic control | Primary efficacy endpoint<br>Noninferiority of IDeg U100 versus IGlar U300 in controlling glycemic levels during hospitalization, measured by'<br>Mean daily BG levels during the first 12 days after randomization.<br>Secondary efficacy endpoints<br>The proportion of BG readings within the target range (70–180 mg/dl) before meals<br>4-point BG readings using POC glucometers for all patients.<br>CGM subgroup:<br>Percentages of time sensor glucose measurements were within the target range (70–180 mg/dl), above the target range (> 180 mg/dl), or below the target range (< 70 mg/dl).<br>Glycemic variability:<br>Measured by the CV of glucose values<br>Adverse events and safety endpoints:<br>Hypoglycemia and hospital complications (cardiovascular complications, acute kidney injury, moderate pleural effusion/consolidation, sternal wound infections, and mortality during the hospital stay) | No significant differences (IDeg vs IGlar): mean daily BG concentrations (157 vs. 162 mg/dl)<br>% of readings within the target BG range of 70–180 mg/dl (74% vs. 73%)<br>Comparable daily basal insulin doses (19 vs. 21 units/day), length of hospital stay (median [interquartile range, IQR]: 9 days in both groups), and hospital complications (21.3% vs. 21.4%)<br>Proportion of patients with BG < 70 mg/dl (15.6% vs. 23.1%) or < 54 mg/dl (1.6% vs. 4.3%) |

**Table 3** continued

| Study | Study design | Study population | Endpoints | Outcomes |
|---|---|---|---|---|
| Suzuki et al., 2019 [45] | Open-label, multicenter RCT | A total of 74 insulin-naïve hospitalized patients with T2DM | Primary endpoint: achievement of target glycemic control within the first 12 days, time (in days) taken to achieve the target glycemic control, and glycemic control assessment (conducted via 6-point SMBG throughout the day)<br>Secondary endpoint: average BG levels and glycemic variability (SD, CV, and MAGE)<br>Safety endpoint: frequency of hypoglycemia | Mean daily BG on day 12: 136.6 ± 6.0 mg/dl (IDeg) vs. 136.7 ± 5.6 mg/dl (IGlar)<br>Time to target glycemia: 8.7 days vs. 8.0 days<br>No significant difference in basal insulin doses on day 7 (6.3 ± 3.0 units/day for IDeg vs. 7.3 ± 3.1 units/day for IGlar) and day 12 (6.4 ± 4.7 units/day for IDeg vs. 7.9 ± 4.6 units/day for IGlar).<br>Comparable hypoglycemia |

Table 3 continued

| Study | Study design | Study population | Endpoints | Outcomes |
|---|---|---|---|---|
| Ponzani et al., 2020 [44] | Prospective observational study<br>Key subgroup<br>Subgroup: 35 out of 65 patients were previously on glargine U100 but were switched to IDeg during the study<br>Comparison group: 30 patients who continued glargine U100 served as the control group | 65 patients | Primary endpoint: evaluation of average glycemic compensation<br>Safety endpoint: occurrence of hypoglycemia | Reduced fasting BG and pre-dinner BG in the IDeg switch group:<br>Glycemic variability: Morning SD declined from 45.2 to 25.6.<br>Hypoglycemia: Daytime hypo fell from 25% to 15%; nocturnal hypoglycemia dropped from 5% to 0%. |
| Simioni et al., 2017 [43] | Retrospective study | A total of 52 noncritical patients (five with T1DM and 47 with T2DM) | Primary endpoint: efficacy and safety of IDeg in a basal–bolus regimen in noncritical hospitalized patients<br>Safety endpoint: occurrence of hypoglycemia | FPG: decreased from 237 mg/dl to 142 mg/dl ($p < 0.0001$) after 4 days, ~153 mg/dl at discharge.<br>Reduction in Glycemic variability<br>No severe hypoglycemia |

**Table 3** continued

| Study | Study design | Study population | Endpoints | Outcomes |
|---|---|---|---|---|
| Fatati et al., 2018 [46] | Observational longitudinal retrospective study | A total of 26 patients (13 with and 13 without diabetes) on parenteral/enteral nutrition<br>treated with IDeg ± Bolus | Primary endpoint: mean BG and glycemic variability (CV%) during hospitalization | Glycemic variability (CV):<br>Decreased from 14 to 11% (in non-diabetes) and from 20 to 9% (diabetes)<br>No symptomatic or severe hypoglycemia noted |
| Takeishi et al., 2016 [47] | Prospective observational study | A total of 12 patients with T2DM undergoing total colonoscopy | Primary endpoint: safety of IDeg, specifically<br>Frequency of hypoglycemia<br>Hypoglycemia index<br>Mean glucose level and SD during the daytime fasting period (fasting between 08:00 and 18:00) on the day of TCS.<br>Secondary endpoint: Comparison of parameters (change in the mean glucose level) between<br>Daytime fasting period (fasting day of TCS)<br>Daytime control period (nonfasting between 08:00 and 18:00 on the day before TCS)<br>SD during the daytime control period | Mean BG during fasting day vs. control day: 141.3 ± 31.5 vs. 191.0 ± 50.8 mg/dl ($p = 0.003$)<br>SD reduced significantly during daytime fasting period<br>No episodes of hypoglycemia |
| Bulisani et al., 2015 [48] | Case series (retrospective analysis) | A total of 10 hospitalized patients with diabetes (T1DM and T2DM)<br>Switched from IGlar U100 to IDeg | Primary endpoint: Glycemic variability (SD and CV), insulin dose, and hypoglycemia | After switching from IGlar U100 to IDeg<br>57% showed improved glycemic variability<br>Severe hypoglycemia events diminished |

*RCT* randomized controlled trial, *BG* blood glucose, *OADs* oral antidiabetic drugs, *IDeg* insulin degludec, *IGlar* insulin glargine, *LOS* length of stay, *T2DM* type 2 diabetes mellitus, *CABG* coronary artery bypass grafting, *CGM* continuous glucose monitoring, *POC* point-of-care, *CV* coefficient of variation, *SD* standard deviation, *MAGE* mean amplitude of glycemic excursions, *SMBG* self-monitoring of blood glucose, *T1DM* type 1 diabetes mellitus, *FPG* fasting plasma glucose, *TCS* total colonoscopy

fasting BG decreased from 176.6 ± 27.9 mg/dl to 130.4 ± 36.6 mg/dl, and predinner BG decreased from 217.9 ± 36.7 mg/dl to 170.9 ± 49.1 mg/dl. Glycemic variability, expressed as the mean of morning SD, reduced from 45.2 to 25.6, whereas the percentage of patients reaching the target fasting BG upon awakening increased from 10 to 65%. Moreover, the incidence of daytime hypoglycemia decreased from 25 to 15% and nocturnal hypoglycemia dropped from 5 to 0%. In contrast, in the group that switched to IGlar U100, significant reductions in BG were observed only in the prelunch range (− 43.8 mg/dl, $p < 0.001$), with higher rates of daytime hypoglycemia (26%) and persistent nocturnal hypoglycemia (2%) [44]. These findings highlight the efficacy of IDeg in reducing glycemic variability and minimizing hypoglycemia compared with IGlar U100.

A multicenter RCT by Suzuki et al. compared IDeg U100 and IGlar U100 in 74 insulin-naïve patients (aged 20–80 years) with T2DM. Both insulins achieved nearly identical mean BG levels and similar time to achieve the target glycemic control.. Glycemic variability, assessed through self-monitoring blood glucose on day 7 and day 12 and continuous glucose monitoring (CGM) on day 11 and 12, showed comparable results between the two groups. On day 11, the CGM glucose mean was 127.2 ± 23.9 mg/dl for IDeg versus 122.3 ± 17.5 mg/dl for IGlar U100 ($p = 0.407$). Other CGM metrics were also similar, with SD at 33.2% ± 15.1% versus 31.9% ± 9.9% ($p = 0.721$), coefficient of variation (CV) at 26.7 ± 13.2 mg/dl versus 26.4 ± 8.7 mg/dl ($p = 0.940$), and the mean amplitude of glucose excursions at 49.3 ± 23.1 mg/dl versus 47.3 ± 13.9 mg/dl ($p = 0.713$). The occurrence of hypoglycemia was also comparable between the groups [45]. These findings suggest that both insulins had comparable glycemic control and safety, potentially offering similar benefits in inpatient management.

Fatati et al. examined the effects of IDeg in a longitudinal observational study of 26 patients (13 with diabetes and 13 without diabetes; mean age 66.3 ± 13.4 years) receiving parenteral or enteral nutrition. After 7 days of IDeg therapy, glycemic variability, as measured by CV, decreased from 14 to 11% in patients without diabetes and from 20 to 9% in patients with diabetes. No symptomatic or severe hypoglycemia occurred [46]. These findings suggest that IDeg is effective in stabilizing BG levels in hospitalized patients with fluctuating metabolic demands, such as those receiving nutritional support, further supporting its role in complex inpatient scenarios.

The utility of IDeg in specialized inpatient settings where fasting is required for medical procedures was explored by Takeishi et al. in a study involving 12 patients with T2DM (mean age: 65.6 ± 11.3 years) already on IDeg and undergoing total colonoscopy (TCS). CGM was conducted for 4 days, starting two evenings before TCS and continuing until the morning after the procedure. Patients fasted for 24 h prior to TCS, and IDeg was discontinued only on the morning of the procedure. The study found that IDeg significantly lowered mean BG levels and SD during the daytime fasting period (08.00–18.00 h the day of TCS) compared with the daytime control period (08.00–18.00 h the day before TCS; 141.3 mg/dl ± 31.5 vs. 191.0 mg/dl ± 50.8, $p = 0.003$ and 15.6 mg/dl ± 6.5 vs. 43.0 mg/dl ± 20.1, $p = 0.001$, respectively). No hypoglycemic episodes occurred during the daytime fasting period [47]. These results underline the ability of IDeg to maintain glycemic stability during fasting periods, a common requirement for medical procedures in hospital settings.

In a smaller case series involving 10 patients with both T1DM (mean age 46 years) and T2DM (mean age 70 years), Bulisani et al. reported that 57% of patients experienced improvements in glycemic variability, as measured by reductions in SD and maintained CV [48]. Additionally, severe hypoglycemic events diminished after switching from IGlar U100 to IDeg, further supporting that IDeg offers advantages in terms of both glycemic control and safety in hospitalized patients.

The above-discussed studies provide strong evidence for the effective management of hyperglycemia in inpatient settings, where the unique attributes of IDeg can be utilized to address the challenges and needs unique to hospitalized patients. These studies set a foundation and provided evidence to support the argument for IDeg attributes translating into meaningful

clinical benefits, especially in diverse inpatient populations where optimal glucose management is crucial for enhancing patient outcomes.

## ATTRIBUTES OF IDEG AIDING USE IN INPATIENT SETTINGS

### Early Onset of Action

The early onset of action (~1 h) of IDeg, which confers rapid glycemic control [2, 35], makes it an ideal choice for hospital use where timely BG management is crucial. Studies such as Galindo et al. and Suzuki et al. highlight the ability of IDeg to achieve the ADA-recommended BG targets early in treatment. Galindo et al. found no difference in the mean daily BG after day 1 between IDeg and IGlar U100, with IDeg achieving a mean BG level within the ADA target range of ≤ 180 mg/dl [25]. This early action helps mitigate the risk of uncontrolled hyperglycemia in hospitalized patients.

### Efficacy

IDeg has demonstrated consistent efficacy across multiple studies, effectively providing glycemic control with minimal variability and low rates of hypoglycemia in various inpatient settings. Galindo et al. and Suzuki et al. both showed that IDeg achieved mean daily BG levels comparable to IGlar U100, with similar proportions of patients reaching the target glycemic control [25, 45]. Kuchay et al. noted FPG control with IDeg superior to that with IGlar U300, along with a higher percentage of BG readings in the optimal range (70–140 mg/dl) [42].

A study by Simioni et al. further highlighted a significant reduction in FPG from 237 to 142 mg/dl ($p < 0.0001$) after 4 days [43]. Ponzani et al. also highlighted significant reductions in premeal BG levels [44], while Fatati et al. demonstrated stable BG control in patients requiring nutritional support [46]. Importantly, these studies highlight the ability of IDeg to maintain glycemic control with low rates of hypoglycemia, particularly nocturnal episodes [43, 47]. IDeg's flexibility, as demonstrated by Simioni et al., and ability to maintain stable BG during fasting periods further emphasize its efficacy and safety in inpatient settings [43, 47].

Moreover, various studies have shown that IDeg achieves glycemic control comparable to IGlar without necessitating an increase in insulin dose. Kuchay et al. found no significant difference in basal insulin doses between IDeg and IGlar U300 (and Galindo et al. reported nearly identical basal insulin doses for IDeg and IGlar U100 [25, 42]. Suzuki et al. further confirmed that IDeg provided comparable glycemic control at lower insulin doses by day 12 compared with IGlar [45]. These findings highlight the ability of IDeg to maintain glycemic stability with similar or even lower insulin doses, which is especially beneficial for long-term inpatient management.

Collectively, these findings underline the consistent efficacy of IDeg in inpatient settings, providing reliable glycemic control and a favorable safety profile without the need for increased insulin doses.

### Low Glycemic Variability

One major advantage of IDeg is its ability to reduce glycemic variability, a critical factor in managing both hyperglycemia and hypoglycemia in inpatient settings. Various studies, including those by Heise et al., have consistently shown significantly lower within-day and day-to-day variability for IDeg than with IGlar U100 and IGlar U300, irrespective of experimental conditions [49].

Particularly, Kuchay et al. found a significantly higher percentage of BG readings within the target range of 70–140 mg/dl with IDeg than with IGlar U300, with ~75% of readings falling within the broader target range of 70–180 mg/dl [42]. Similarly, Simioni et al. reported that IDeg reduced the SD of BG from 125 to 37.7 mg/dl ($p < 0.0001$) at discharge, showing its rapid effect in stabilizing glucose levels [43]. Ponzani et al. similarly reported a significant reduction in morning BG SD, along with a marked decrease in hypoglycemia rates in patients who switched to IDeg, emphasizing its ability to manage glycemic variability [44].

Furthermore, a reduction in glycemic variability reduces the risk of complications related to glucose instability, such as severe hypoglycemia or hyperglycemia, and offers a safer and more reliable option for inpatient hyperglycemia management. Fatati et al. demonstrated that IDeg was particularly effective in maintaining stable glucose levels in patients receiving nutritional support, a population likely to have fluctuations in BG levels, with a decrease in CV from 20 to 9% in patients with diabetes [46]. The predictable action profile of IDeg makes it highly effective for patients with complex metabolic needs, including those in surgical units.

### Dosing Flexibility

Dosing flexibility is another standout feature of IDeg, making it especially useful in inpatient settings where patients often have fluctuating insulin requirements. Unlike some other basal insulins, the flexible dosing interval of IDeg ranges from 8 to 40 h without significantly affecting its efficacy, making it convenient for noncritical care settings. Simioni et al. reported that IDeg was administered in the morning to 44.2% of patients and in the evening to 55.8%, based on clinical needs, without compromising glucose control. At discharge, 78.9% of patients had BG levels within the recommended target (i.e., < 180 mg/dl) [43]. Additionally, Takeishi et al. demonstrated that IDeg maintained stable glucose levels even during fasting periods in procedural settings, such as TCS, further reinforcing its dosing flexibility [47]. This adaptability makes IDeg an attractive option for managing glycemia in a variety of clinical scenarios, including perioperative care and complex medical cases.

### Ease of Titration

The ease of daily titration with IDeg allows fine-tuned control of BG levels in hospitalized patients. Galindo et al. highlighted that IDeg could be safely titrated daily (to a target glucose: 70–180 mg/dl) to maintain optimal glycemic control without an increased risk of hypoglycemia [25]. Similarly, Kuchay et al. reported that the daily titration of IDeg in perioperative patients undergoing CABG was safe and resulted in low rates of hypoglycemia, comparable to IGlar U300 [42]. This ability to adjust doses daily is especially beneficial for hospitalized patients whose insulin requirements may change because of factors such as infection, surgery, or changes in nutritional intake.

### Low Risk of Hypoglycemia

The safety profile of IDeg, particularly its low risk of hypoglycemia, is one of its most compelling attributes for inpatient use. IDeg has consistently shown a significant reduction in hypoglycemic episodes, especially nocturnal hypoglycemia, compared with other basal insulins. Ponzani et al. reported that no patients treated with IDeg experienced nocturnal hypoglycemia, whereas 2% of those receiving IGlar experienced it. Furthermore, daytime hypoglycemia rates had reduced from 25 to 15% in the IDeg group [44]. Further supporting its safety, Simioni et al. also reported no severe hypoglycemic episodes in hospitalized patients treated with IDeg, reinforcing its low risk of hypoglycemia in acute care settings [43]. Even in complex patient populations, such as those receiving parenteral or enteral nutrition, IDeg has been shown to provide stable glucose control without inducing severe hypoglycemia [46].

Notably, a study by Kuchay et al. demonstrated that while no significant differences were observed between IDeg and IGlar U300 in terms of the mean daily BG levels or basal insulin doses, both groups spent a similar percentage of time within the target glucose range (70–180 mg/dl) and had a comparable time above the target range (> 180 mg/dl). However, the incidence of level 1 hypoglycemia (BG < 70 mg/dl) was lower with IDeg (15.6% vs. 23.1% for IGlar), and level 2 hypoglycemia (BG < 54 mg/dl) was also reduced in the IDeg group (1.6% vs. 4.3% for IGlar). Importantly, no severe hypoglycemic events were reported in either group, reaffirming the safety of IDeg in managing inpatient hyperglycemia

in surgical patients [42]. Similarly, Galindo et al. found comparable hypoglycemia rates between IDeg and IGlar U100, with no significant differences in the rates of level 1 hypoglycemia (BG < 70 mg/dl), further supporting the safety profile of IDeg, with glycemic control comparable to IGlar U100 [25].

### Special Populations

Because of its unique attributes and approved indications, IDeg can be used for special populations, including the elderly and individuals with T1DM. In elderly patients, including those above 70 years (who often present with complex comorbidities and varying insulin needs), the stable and consistent glucose-lowering effect of IDeg, with minimal peak action, significantly reduces the risk of hypoglycemia, especially nocturnal episodes [43, 44, 49, 50]. These studies emphasize the ability of IDeg to maintain glycemic control in older adults while maintaining a low incidence of hypoglycemia.

For patients with T2DM, including younger adults (aged 20–80 years as studied by Suzuki et al., 2019), the ultralong duration of action of IDeg supports steady glucose levels throughout the day, minimizing fluctuations and offering flexible dosing [51, 52]. Its flexibility to be administered at any time of the day without compromising efficacy is particularly beneficial for this group [45].

## DISCUSSION

The management of in-hospital hyperglycemia is critical to patient care, as poorly controlled BG levels are associated with increased morbidity and mortality in patients both with and without diabetes. The selection of an appropriate basal insulin is paramount in achieving optimal glycemic control while minimizing the risk of hypoglycemia [26]. In this context, IDeg has emerged as an effective and safe option for managing hyperglycemia in hospitalized patients.

In-hospital glycemic control is essential because of the association between elevated BG levels and adverse outcomes, including increased infection rates, prolonged hospital stays, delays in surgical procedures, and higher mortality, particularly among patients with diabetes. Achieving steady and safe glycemic control is challenging in inpatient settings, particularly in a situation exacerbated by stress-induced hyperglycemia, irregular meal patterns, or fasting before surgery. Therefore, an ideal basal insulin for hospitalized patients should have predictable PK and PD properties, enabling effective and safe BG management across various clinical scenarios. IDeg aligns closely with these characteristics, thereby being a valuable option for inpatient use.

One distinguishing feature of IDeg is its fast onset of action (0.5–1.5 h), which is shorter than IGlar formulations (2–4 h for IGlar U100 and 6 h for IGlar U300) [53]. Furthermore, IDeg achieves a steady state within 2–3 days [54], which is faster than IGlar U300 (5 days) [55] and comparable to IGlar U100 (2–4 days) [56]. These properties support its use for rapid stabilization of BG levels in hospitalized settings. IDeg has been found to achieve mean BG levels within the ADA-recommended targets (100–180 mg/dl) as early as 1 day after initiation, helping mitigate the risk of uncontrolled hyperglycemia in hospitalized patients [1, 25]. Simioni et al. reported significant reductions in FPG [43]. Furthermore, the data from Kuchay et al. revealed that reductions in FPG were significantly higher with IDeg than with IGlar U300 from admission to discharge [42], suggesting an advantage in cases requiring substantial FPG reduction. The reviewed data substantiate the role of IDeg in managing hospitalized patients with established efficacy in achieving and maintaining BG levels as per the established glycemic target goals.

Preventing wide BG fluctuations is a major challenge in inpatient settings, which can worsen outcomes, such as hypoglycemia, infections, and longer hospital stays [3, 4]. Achieving a stable glycemic profile is crucial in hospitalized patients to avoid complications and improve recovery times. In this context, IDeg's ultralong duration of action and flat PK profile provide a unique advantage over other basal insulins, such as IGlar U100/U300 [50]. IDeg demonstrated a higher mean percentage of BG readings within the target ranges (100–140 mg/dl) than IGlar [42]. Additionally, IDeg showed low glycemic

variability, with a CV of 9%, which falls well within the Advanced Technologies & Treatments for Diabetes (ATTD)/ADA-recommended target of ≤ 36% [46, 57]. Low variability is crucial in minimizing risks associated with extreme BG fluctuations, which can significantly impact patient outcomes. Monnier et al. support this by suggesting that a CV below 36% serves as an effective threshold to distinguish stable from unstable glycemia, as values exceeding this limit are associated with an increased hypoglycemia risk [58]. Emerging evidence further indicates that IDeg's ability to reduce glycemic excursions contributes to improved patient outcomes in hospital care.

Hypoglycemia in hospitalized patients is a significant barrier to effective glycemic management and adversely impacts patient outcomes. It is associated with increased mortality, cardiovascular risks, length of hospital stay, and healthcare costs [59, 60], with a mortality rate of 28.3% over 3 years following the episode of severe hypoglycemia [61]. The economic impact includes a cost increase of up to 39% and an average of three additional days in hospital stay for patients experiencing hypoglycemia [62, 63]. A key advantage of IDeg lies in its low rates of hypoglycemia, including nocturnal hypoglycemia [44], attributed to its steady release and low peak-to-trough ratio. Many studies have also reported no episodes of severe hypoglycemia with IDeg treatment [25, 42, 43, 46]. Collectively, these findings clearly highlight the low risk of hypoglycemia with IDeg, making it a valuable tool in providing stable glycemic management with the potential to reduce both clinical and economic burdens.

Furthermore, IDeg's flexible dosing interval, ranging from 8 to 40 h, offers a distinct advantage in hospital environments, where fasting for diagnostic procedures, surgeries, chemotherapy, or nutritional support may interrupt strict dosing schedules [35, 46, 47]. This flexibility not only enhances clinical outcomes but also reduces operational burdens, minimizing the risk of missed doses and alleviating the demands on hospital staff. The smooth transition from intravenous bolus insulin infusion in critical care to subcutaneous administration in noncritical care settings is facilitated by the early onset of IDeg, ensuring timely glycemic control. Furthermore, the ease of daily titration [25, 42] simplifies patient management in noncritical care. Besides its clinical benefits, IDeg's user-friendly delivery device enhances safety by minimizing dosing errors, making it a practical choice for hospitalized patients [64]. Although the device itself is not the primary factor in IDeg's clinical utility, the ease of use complements its PK profile, enhancing the overall quality of patient care. IDeg's flexible dosing, early onset of action, and ability to be titrated daily makes it ideal for complex hospital settings, where patient needs vary, and timely glycemic management is critical. This adaptability, combined with its user-friendly delivery device, aligns well with clinical and patient-care priorities, supporting safe and efficient inpatient hyperglycemia management.

IDeg demonstrates a tailored safety and efficacy profile in special patient populations, making it particularly suitable for a wide range of patients, including those with T1D and T2D, elderly patients, and even those receiving enteral nutrition or undergoing surgical procedures like CABG, where it provides stable BG management without increasing the risk of hypoglycemia.

This adaptability becomes even more critical when managing elderly patients, who often require nuanced and individualized care. With the global increase in the older population, it is essential to understand the characteristics of older patients with or without diabetes and develop effective strategies for managing this population. While glycemic control remains a priority to prevent diabetes-related complications, managing diabetes in frail older adults becomes increasingly complex because of factors such as multimorbidity, cognitive impairment, polypharmacy, and functional decline [65]. Diabetes prevalence in this age group is high, affecting about 20% of those aged 65–75 years and up to 40% of individuals over 80 years [66]. Hospitalized elderly patients face a substantial risk of both hyperglycemia and hypoglycemia, with over 70% of those over 65 years of age experiencing hyperglycemia in hospital settings. The NICE-SUGAR trial demonstrated the severity of this issue, with 45% of elderly patients experiencing hypoglycemia,

where severe cases correlated with increased mortality rates [66].

IDeg's long and stable action profile, along with its low peak-to-trough ratio, minimizes the need for frequent dose adjustments and reduces hypoglycemia risk, making it highly beneficial for elderly patients often requiring more stable glycemic control with minimal fluctuations [35, 39]. Multiple studies in this review support IDeg's utility in elderly patients; for instance, Ponzani et al. demonstrated an improved hypoglycemia outcome in older adults with T2DM, while studies by Kuchay et al., Suzuki et al., Fatati et al., and Takeishi et al. reinforce IDeg's efficacy and safety profile in older hospitalized patients [42, 44–47]. Simoni et al. included an elderly population of > 75 years of age, where IDeg was found to be effective and minimized glucose variability and nocturnal hypoglycemia [43]. Collectively, these studies affirm that IDeg offers a safe and stable glycemic management approach for elderly patients, helping mitigate the risks associated with this population.

IDeg is effective and well tolerated in patients with hepatic or renal impairment, as its PK properties are preserved in these populations, allowing safe use without extensive dose adjustments [67, 68]. IDeg also supports glycemic control in renal transplant patients, effectively lowering fasting and postprandial glucose levels during early post-transplant care, making it suitable for patients with compromised organ function and reducing the risk of adverse glycemic events [41]. Similarly, in pregnant women, where tight glycemic control is essential, the EXPECT trial demonstrated IDeg's comparable efficacy and safety to IDet, with similar HbA1c levels and low rates of severe hypoglycemia [40].

### Limitations

While the reviewed studies provide valuable insights into the use of IDeg in hospitalized patients, they have several limitations. Some studies, such as the trials conducted by Bulisani et al. and Takeishi et al. with relatively small sample sizes, may restrict the generalizability of their findings to larger, more diverse populations. The nondiabetes cohort in the study by Fatati et al. primarily consisted of prediabetes individuals, limiting the applicability of the results to patients without diabetes. Moreover, not all studies incorporated CGM to assess glycemic variability and relied instead on intermittent BG measurements. Furthermore, there are limited head-to-head inpatient trials comparing IDeg with other newer insulins, which restricts direct comparisons of efficacy, safety, and other clinical benefits. These limitations highlight the need for further research with larger sample sizes and more robust methodologies to better assess the full impact of IDeg on various inpatient populations.

## CONCLUSIONS

This review highlights the comprehensive benefits of IDeg in the inpatient setting, emphasizing its efficacy, dosing flexibility, and safety as essential features that meet the diverse needs of hospitalized patients. IDeg's unique PK and PD properties make it a valuable choice in hospital protocols for effective glycemic management, particularly in special populations and complex metabolic scenarios where precise control is critical. Its clinical advantages are especially evident in high-risk groups, enhancing patient outcomes through stable and consistent glucose control. As IDeg continues to be integrated into hospital care protocols, ongoing research will further clarify its role and potential in optimizing inpatient diabetes management.

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### *Declarations*

***Conflict of Interest.*** Subhash Kumar Wangnoo, Manash P Baruah, Sailesh Lodha, Debmalya Sanyal, Ramesh Goyal, Basavaraj G Sooragonda, Sruti Chandrasekaran, and G Vijay Kumar have nothing to disclose.

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