Short and long-term cost-effectiveness of switching therapy from biphasic human insulin 30 to biphasic insulin aspart 30 in people with type-2 diabetes

1. **Philip Home**
Newcastle University, Newcastle, England

2. **Pradana Soewondo**
University of Indonesia, Jakarta, Indonesia

3. **Zanariah Hussein**
Hospital Putrajaya, Malaysia

4. **Asrul Akmal Shafie**
Universiti Sains Malaysia, Penang, Malaysia

5. **Khaled AlRaddady**
King Saud Medical City, Riyadh, Saudi Arabia

6. **Ranya Baadbad**
Pharmacoeconomics Center of KSMC, Riyadh, Saudi Arabia

7. **Eva Hammerby**
Novo Nordisk A/S, Copenhagen, Denmark

8. **Annie Nikolajsen**
Novo Nordisk A/S, Copenhagen, Denmark

9. **Frederikke Bruun Andersen**
Last Mile P/S, Copenhagen, Denmark

10. **Ole Henriksen**
Last Mile P/S, Copenhagen, Denmark

Objective

- To assess the cost-effectiveness (CE) of switching from biphasic human insulin 30 ± oral glucose-lowering drugs (OGLDs) to biphasic insulin aspart 30 ± OGLDs in people with type 2 diabetes (T2DM) in countries in different economic circumstances based on the A_1chieve® study - an observational study evaluating adverse events and effectiveness of Novo Nordisk insulin analogs in routine clinical practice.

Methods

- The A_1chieve® study is a non-interventional 24 week study including more than 66,000 people with T2DM from 28 countries starting either biphasic insulin aspart 30, insulin detemir and/or insulin aspart.
- The CE analyses included data for people switching to biphasic insulin aspart 30 in Saudi Arabia (n=401) and India (n=866), as well as in four ASEAN* countries (n=175) using Indonesia health costs. Data were collected on clinical effectiveness, adverse events and health-related quality of life using the EQ-5D questionnaire.
- Short-term incremental costs-effectiveness ratios (ICERs) were computed based on incremental cost of treatment and the EQ-5D incremental effect in the first year after switching to biphasic insulin aspart 30.
- Long-term ICERs were simulated using the IMS CORE Diabetes Model† with 30-year time horizon including country-specific costs for complications and therapies and background mortality rates.
- ICERs are expressed as cost per QALY in local currencies, USD and in fractions of local GDP per capita. CE was pre-defined using the WHO Choice programme threshold based on GDP per capita‡.
- The robustness of the estimated ICERs were tested in a series of sensitivity analyses including; expansion of the simulation time horizon from 30 to 50-years, assuming no deterioration of glucose control with time, assuming median and first quartile distribution of treatment effects on HbA_{1c}, including the costs of self-monitoring blood glucose (SMBG) strips and including the costs of 1 and 2 additional general practitioner (GP) visits in the first year after switching to biphasic insulin aspart 30.

Figure 1 Treatment effect on HbA_{1c} at baseline and at week 24.

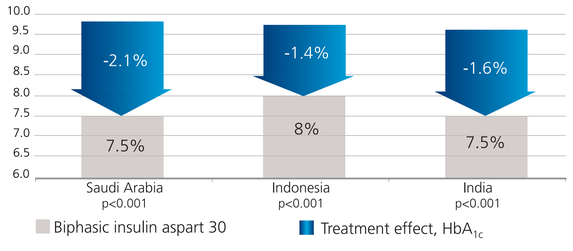
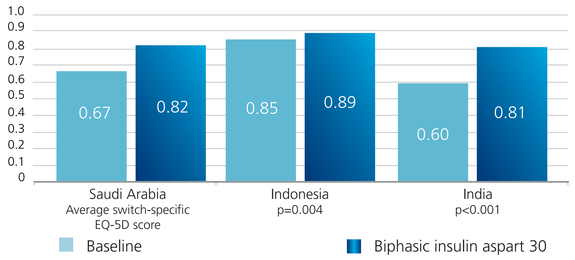


Figure 2 Improvements in patient reported outcomes using the EQ-5D questionnaire when switching to biphasic insulin aspart 30.



Results

- Across all country settings, 13% of the 3000 bootstrap replications of ICERs were dominant, 58% were highly cost-effective, 29% were cost-effective and 0% were not cost-effective based on a 30-year time horizon (*see figure 3*).
- Predicted life-expectancy increased in all countries: Saudi Arabia (1.22), Indonesia (0.81) and India (0.76) (*see figure 4*).
- The relative risk of developing selected complications was reduced substantially in all countries (*see figure 5*).

Figure 3 ICER scatterplot displaying 3000 bootstrap replications (1000 per country) of incremental costs as GDP per capita and incremental quality-adjusted life expectancy (Incremental QALE)†.

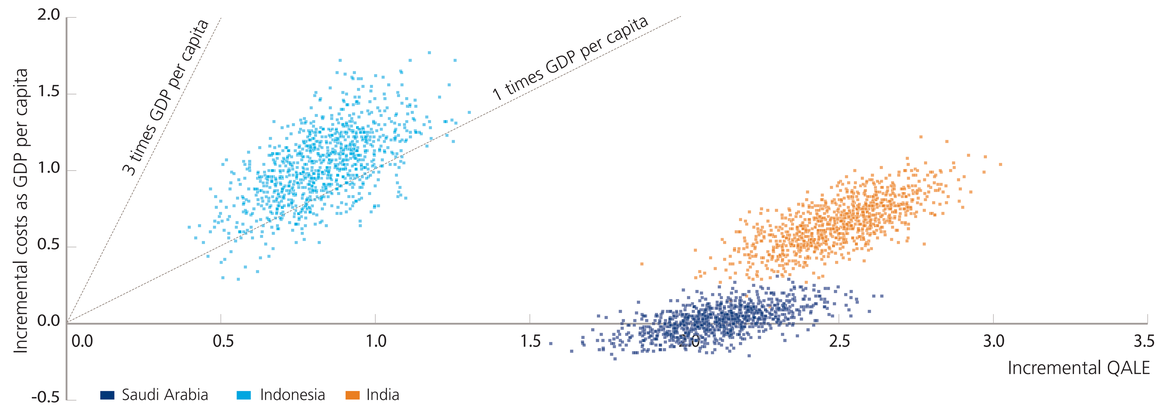


Figure 4 Current life expectancy in the general population and simulated life expectancy at baseline and in people switching to biphasic insulin aspart 30.

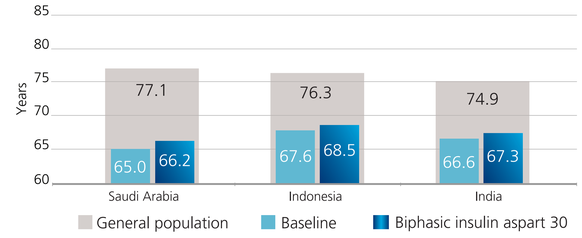


Figure 5 Relative risk reduction in selected complications over 30 years simulated in the IMS CORE Diabetes Model.

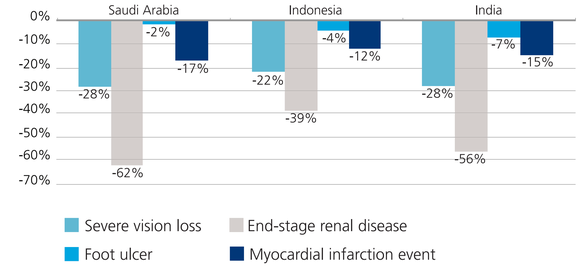


Table 1 1-year and 30-year ICERs (base case) per QALY gained.

Country	1-year ICER			30-year ICER (base case)		
	Local currency	USD	Fraction of GDP	Local currency	USD	Fraction of GDP
Saudi Arabia	SAR 12,913	3,443	0.17	SAR 837	223	0.03
Indonesia	IDR 120,507,714	12,520	2.92	IDR 51,416,633	5,342	1.25
India	INR 36,001	649	0.44	INR 21,696	391	0.26

Table 2 Sensitivity analyses presented as fraction of GDP per capita per QALY gained.

Country	50-year time horizon	No HbA_{1c} deterioration	Median treatment effect (HbA_{1c})	Quarter 1 treatment effect (HbA_{1c})	Including costs of SMBG strips	1 additional GP visit in the first year after switch	2 additional GP visits in the first year after switch
Saudi Arabia	0.01	0.02	0.02	0.07	0.02	0.01	0.01
Indonesia	1.23	1.24	1.29	2.09	1.34	1.25	1.26
India	0.27	0.28	0.28	0.35	0.29	0.27	0.27

Conclusions

- Switching from biphasic human insulin 30 ± OGLDs to biphasic insulin aspart 30 ± OGLDs in T2DM as performed in the A_1chieve® study was found to be cost-effective across all country settings at 1 and 30-year time horizons.
- Sensitivity analyses showed the long-term cost-effectiveness to be robust.
- Predicted life-expectancy increased and the relative risk of complications was reduced across all country settings based on a 30-year time horizon.

*Indonesia, Malaysia, Singapore and the Philippines

†The IMS Core Diabetes Model[1] (CDM) is an interactive computer simulation model of diabetes (type 1 and type 2), comprising of 15 inter-dependent sub-models accounting for the complications related to diabetes. Each Markov sub-model uses time-, state-, and diabetes type-dependent probabilities derived from published sources to obtain projected outcomes relevant to specific patient groups and country settings of interest. Patient cohorts are defined in terms of age, gender, baseline risk factors and pre-existing complications. Local disease management components, costs as well as background mortality rates for causes of death not determined by the CDM are loaded into the CDM.

‡The World Health Organization (WHO) Choice programme[2] recommends a threshold based on GDP per capita. A health technology is labelled:
- "Not cost-effective" – if costs ≥ 3 times GDP per capita
- "Cost-effective" – if costs ≥ 1 and ≤ 3 times GDP per capita
- "Highly cost-effective" – if it costs ≤ GDP per capita

The health technology is referred to as "Dominant" if the costs per life year gained are below 0

1. Palmer AJ, et al. The CORE Diabetes Model: projecting long-term clinical outcomes, costs and cost-effectiveness of interventions in diabetes mellitus (types 1 and 2) to support clinical and reimbursement decision-making. Curr Med Res Opin. 2004;20(8):5-26
2. WHO Choice Programme. Available online at: http://www.who.int/choice/costs/CER_thresholds/en/index.html