

METHOD TO CALCULATE ESA DOSE TO ACHIEVE TARGET HAEMOGLOBIN LEVEL BY ANALYSING HAEMOGLOBIN KINETIC MODEL

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EQUATIONS TO DETERMINE ESA DOSE

Traditionally, feedback control approaches have been employed to determine the dose of erythropoiesis-stimulating agents (ESA) administered. However, these approaches often cause greater haemoglobin (Hb) fluctuation. Thus, we developed the following Hb kinetic model (HKM) method to calculate the ESA dose to achieve a target Hb level.

Step 1: Calculate the monthly Hb production that gives the target Hb concentration (i.e., Target Hb Production).

Equation 1: Total Amount of Hb in Blood at Target Concentration = Target Hb Concentration × Blood Volume

Equation 2: Total Amount of Hb in Blood at Target Concentration = Target Hb Production × Erythrocyte Lifespan (a month unit)

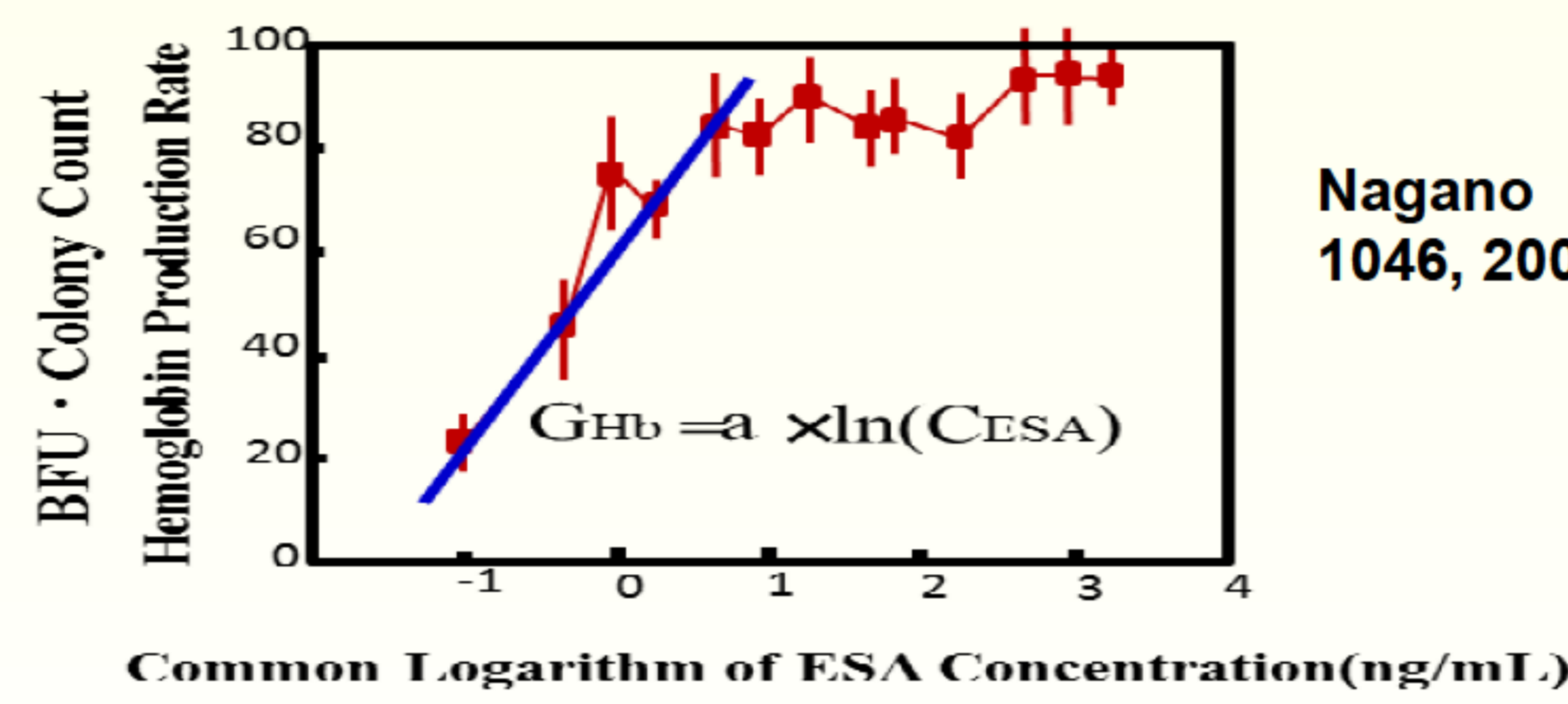
By combining these 2 equations, following Equation 3 is obtained:

Target Hb Production = (Target Hb Concentration × Blood Volume) ÷ Erythrocyte Lifespan

Step 2: Calculate the serum ESA level that gives the target Hb production on the basis of Nagano's formula.

Equation 4: Serum ESA Concentration = Exp (Target Hb Production ÷ a)

Relationship between Hb production and ESA Concentration (in vitro)



Step 3: Calculate the ESA dose that gives the serum ESA level.

METHODS

Forty-seven patients were studied. All of them provided written informed consent. They received darbepoetin alfa (DA) to control Hb in accordance with a common negative feedback control protocol (Kidney Int 2005) for 3 months and were switched to HKM anaemia treatment for 13 weeks. In HKM, required ESA dose is calculated by the above 3 steps.

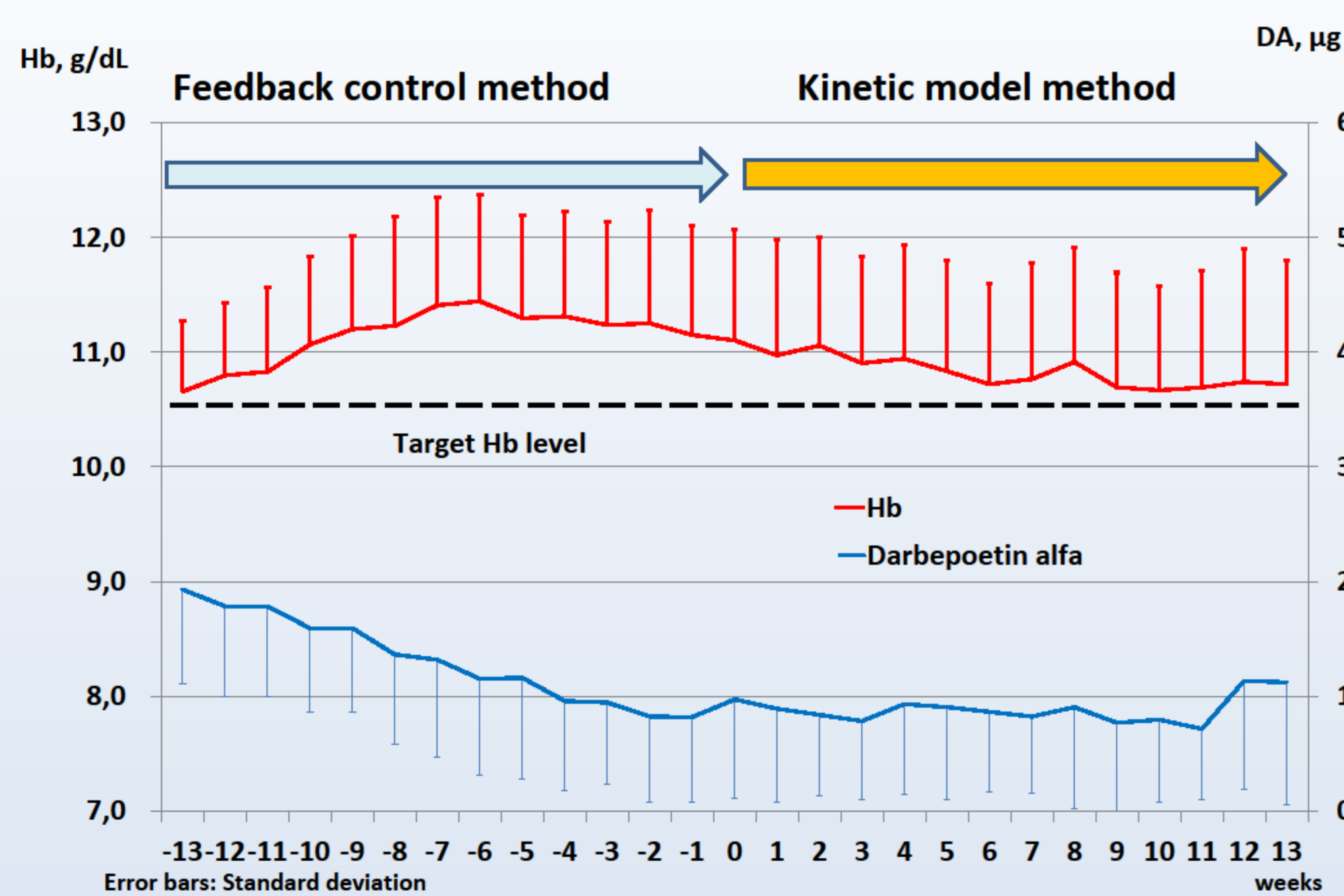
In this study, the target Hb range was set at 10.0-11.0 g/dL. Forty mg of elemental iron were administered intravenously once a week when serum ferritin level was below 100 ng/mL or transferrin saturation was less than 20%.

RESULTS

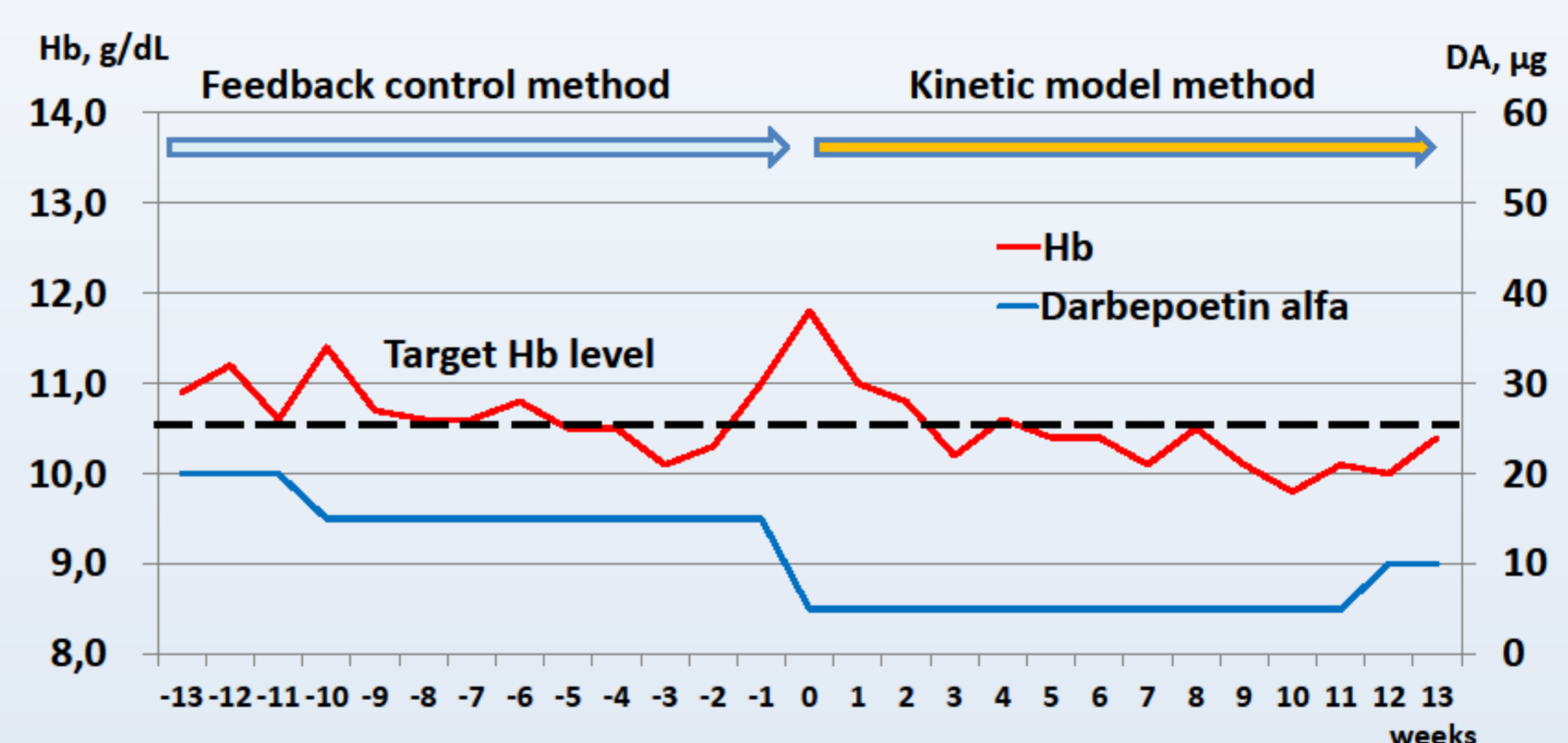
Thirty-seven patients were completed study. Three patients were withdrawn from the study due to hospital admission. Seven patients were withdrawn from the study because they had high ESA resistances for they need 60 µg of DA.

The mean Hb level was 10.7 ± 0.6 g/dL at the start of the HKM method and 10.7 ± 1.1 g/dL at the 13th week. The Hb levels at the 13th week were within the target range in 59.5% of patients, below 10 g/dL in 13.5%, and above 11 g/dL in 27.0%. The absolute value of difference between the center of the target Hb level (i.e., 10.5 g/dL) and measured Hb levels was 0.80 ± 0.75 g/dL at the 13th week. Mean doses of DA for 13th weeks were 11.2 ± 10.7 µg.

Effect of feedback control method and kinetic model method on blood Hb level



ESA dosing methods and required DA dose (Typical case)



CONCLUSIONS

Blood Hb levels were well controlled with minimal fluctuation when the HKM method was employed. These results show effectiveness of the Hb kinetic model.

