

Adjustment of DLCO Measurements

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1. Introduction

The ATS/ERS standard for DLCO published in 2017 justifies the need for an adjustment of DLCO measurements as follows:

Besides varying with age, sex, height and possibly ethnicity, DLCO also changes with Hb, lung volume, COHb, PI_{O_2} [inspired oxygen tension, e.g., altitude] ..., exercise and body position.

Furthermore, the standard states that the adjustment should be made in the predicted rather than the measured DLCO value. This differs from the solution provided in the previous standard of 2005, where the measured value is adjusted.

In the software EasyOne Connect, the adjustments of the DLCO value for Haemoglobin (Hb), Carboxyhaemoglobin (COHb), inspiratory oxygen pressure (PI_{O_2}), and altitude are performed according to the solution proposed by the ATS/ERS standard 2005. ndd chose this solution for backward compatibility and easier comparison of adjusted and non-adjusted values:

- The parameter **DLCO** represents the measured DLCO value without any adjustments. The predicted value provided for this parameter is the non-adjusted value from the predicted equations (see Application Note re Predicted Normal Values available on the ndd website under Resources / Downloads).
- The parameter **DLadj** refers to the measured DLCO value that has been adjusted for Hb, COHb, PI_{O_2} , and altitude. The predicted value is the same as for the non-adjusted DLCO value.

Please note:

- 1) All formulas for the adjustment of DLCO provided in the sections below are derived from the ATS/ERS standard 2017.
- 2) Even without entering values for Hb, COHb, and/or PI_{O_2} , DLadj always differs slightly from DLCO due to the altitude adjustment (see below).

2. Adjustment for Haemoglobin

The following formulas are applied to adjust DLCO for Haemoglobin:

Male adults (age ≥ 15 years), Hb [g/dL]	DLadj = DLCO / (1.7 * Hb / (10.22 + Hb))
Default Hb for male adults	14.6 g/dL (9.00 mmol/L)
Female adults and children (age <15 years), Hb [g/dL]	DLadj = DLCO / (1.7 * Hb / (9.38 + Hb))
Default Hb for female adults and children	13.4 g/dL (8.26 mmol/L)
Unit conversion	Hb [g/dL] = Hb [mmol/L] / 0.616
Allowed range for Hb	0 to 100 g/dL

3. Adjustment for PI_{O_2} or Altitude

The following formula is applied to adjust DLCO for PI_{O_2} if the patient uses supplemental O_2 :

$$\text{DLadj} = \text{DLCO} * (1 + 0.0035 * (PI_{O_2} - 100))$$

PI_{O_2} [mmHg]

If no supplemental O_2 is used the following formulas are applied to adjust DLCO for altitude:

DLadj = DLCO * (1 + 0.0031 * (PI_{O_2} - 150))	PI_{O_2} [mmHg]
$PI_{O_2} = (P_{amb} - 47) * 0.20942$	P_{amb} [mmHg]
Pressure unit conversion	P [mmHg] = P [mbar] * 0.750
Pressure P_{amb} at altitude	$P_{amb} = 760 \times \left(1 - \frac{0.0065 \times h}{288}\right)^{5.255}$, [mmHg], h in [m]
Allowed range for P_{amb}	100 to 750 mmHg
Feet to meter conversion	h [m] = h [ft] / 3.28084

4. Adjustment for COHb

Adjustment for Carboxyhaemoglobin is performed as follows:

DLadj = DLCO / (102% - COHb)	COHb in %
Allowed range for COHb	0 to 100%
COHb default value	2%

5. Example for DLCO Adjustment

The following table shows how combined adjustments are performed:

Factor	Adjustment for male adults (age ≥ 15 years)	Adjustment for female adults and children (age < 15 years)
Haemoglobin 32.4675 mmol/L	0.7023	0.69292
PI_{O_2} 400 mb	1.7	1.7
COHb 30%	1.38889	1.38889
Total adjustment factor	1.6582	1.6361

The total adjustment factor applied when computing DLadj is the multiplication of all three adjustment factors.