



## The Carbon Monoxide Diffusing Capacity\* Clinical Implications, Coding, and Documentation

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The test for the diffusing capacity of the lung for carbon monoxide (DLCO) has been available for nearly 100 years for research and clinical purposes. The single-breath method is used almost exclusively in the United States. It has been available in clinical pulmonary function laboratories for > 50 years. DLCO has great value in evaluating patients with lung diseases. Guidelines to standardize DLCO have been published by the American Thoracic Society and European Respiratory Society to reduce the interlaboratory variability that has existed. One code, 94720, should be reported for the billing for DLCO. Another code, 94725, the membrane diffusing capacity, exists for the measurement of the membrane and blood components of the DLCO. Currently, no clinical indications exist for the use of the membrane diffusing capacity. The finding that the number of tests in the Medicare population coded with 94725 has increased by > 1,000% from 2000 to 2005 is quite surprising. This rate is 14-times higher than the rate of increase in the utilization of 94720 over the same period. The possible reasons for these increases are discussed, but the most likely explanation is the financial gain derived from coding 94725. It is proposed that coding and billing of 94725 be stopped until the clinical indications for membrane diffusing capacity have been established. Those who code and bill for 94725 must be prepared to justify the use of this code to Medicare and third-party payers. (CHEST 2008; 134:663-667)

**Key words:** coding; current procedural terminology; diffusing capacity of the lung for carbon monoxide; membrane diffusing capacity; volume-corrected diffusion capacity

**Abbreviations:** ATS = American Thoracic Society; CPT = current procedural terminology; DLCO = diffusing capacity of the lung for carbon monoxide; DLVA = volume-corrected diffusion capacity; DMCO = membrane conduction; ERS = European Respiratory Society; ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; Kco = transfer coefficient;  $\theta V_c$  = blood conduction; PF = pulmonary function; VA = alveolar volume; Vc = pulmonary capillary volume

The diffusing capacity of the lung for carbon monoxide (DLCO) is an important and useful pulmonary function (PF) test. In Europe, it is called transfer factor for carbon monoxide.

### HISTORICAL PERSPECTIVE

The measurement of DLCO is nearly 100 years old. It was introduced by Marie and August Krogh in articles<sup>1-3</sup> published in 1909 and 1915. Both the single-breath and

the steady-state methods have their foundations in these articles. The clinical utility of DLCO did not occur until the infrared carbon monoxide meter was developed in the 1940s. This device allowed relatively easy measurement of

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carbon monoxide, which previously required tedious physical chemistry measurement techniques. Steady-state measurements of DLCO have been utilized in some clinical PF laboratories over the years.<sup>4,5</sup> However, the single-breath method modified by Ogilvie et al<sup>6</sup> has been used for most patient testing.

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Due to the brilliant investigations by Roughton and Forster,<sup>7</sup> DLCO can be divided into membrane conduction (DMCO) and blood conduction ( $\theta Vc$ ) components. To determine the DMCO and pulmonary capillary volume ( $Vc$ ) requires multiple measurements of DLCO using different, carefully measured levels of fraction of inspired oxygen followed by a graphic solution using the resistance equation:

$$1/DLCO = 1/DMCO + 1/\theta COVc$$

where  $\theta$  is a constant describing the conductance of dissolved gas (CO) between the plasma and the interior of the RBC, including the reaction rate with the hemoglobin molecule. These are described clinically as alveolar membrane gas transfer properties. For technical reasons, these determinations have been used primarily for research but not for clinical purposes. No guidelines for use in patient care have been established for fractionating the DLCO into DMCO and  $Vc$ . This may change with the use of nitric oxide together with carbon monoxide in the inspired gas because diffusing capacity of the lung for nitric oxide appears to be equivalent to DMCO.<sup>8,9</sup>

#### MEASUREMENT AND UTILIZATION

To measure DLCO, the seated patient exhales to residual volume, then rapidly inhales a mixture of 0.3% carbon monoxide, air, and a tracer gas. Usually 1 to 5% helium is added as the tracer, but 0.3% methane or 0.5% neon also can be used. The patient holds his/her breath for 10 s and then rapidly exhales. The expired gas is collected for analysis after the initial 750 to 1,000 mL are discarded. Carbon monoxide and the tracer gas concentrations are measured, and DLCO is calculated.<sup>10</sup> The use of a rapidly responding infrared meter allows real-time visual assessment of carbon monoxide to assure the technologist that the gas measurements are made after the dead space has cleared. A second DLCO measurement is made after a wait of 4 to 5 min (to clear the majority of alveolar carbon monoxide by ventilation, but not to clear the carbon monoxide bound to hemoglobin). Subsequent DLCO measurements may be required until two DLCO determinations differ by < 3 mL/min/mm Hg or are within 10% of the highest value.<sup>11</sup> The average of at least two DLCO values is reported. There have been two statements from the American Thoracic Society (ATS) on standardizing the measurement of the DLCO,<sup>12,13</sup> as well as a recent joint statement from the ATS and the European Respiratory Society (ERS).<sup>11</sup> These standards were developed to reduce the wide variability of DLCO measurements (up to 50%) from laboratory

to laboratory.<sup>12,14</sup> Adherence to these standards will reduce interlaboratory variability and allow legitimate comparison of DLCO measurements from one laboratory to another.

DLCO is usually measured in PF laboratories located in hospitals or in large clinics. The equipment may be too expensive for use in PF laboratories located in solo or small practices. There appears to be no significant side effects or contraindications for measuring DLCO.<sup>15</sup> It is valuable to measure DLCO in the initial evaluation of patients with shortness of breath of unknown cause, with obstructive lung disease of any etiology, with restrictive lung disease with or without parenchymal involvement, and with pulmonary vascular diseases.<sup>16</sup> Initially it was believed that DLCO reflected the thickness of the distance between the alveolus and the interior of the RBC.<sup>6</sup> It really is a reflection of the surface area of the lung available for diffusion, the volume of blood in the pulmonary capillaries, and the thickness of the alveolar capillary barrier.<sup>16</sup> The use of DLCO is also important in evaluating the effect of therapy in interstitial and pulmonary vascular diseases and to determine the progression of parenchymal disease in patients with obstructive lung diseases. Most diseases of the lung result in low values for DLCO (Table 1). However, high DLCO values have been reported in patients with obesity, polycythemia, asthma, and pulmonary hemorrhage.<sup>17</sup> The severity of the decrease in DLCO measured in patients also can be assessed<sup>17</sup> (Table 2).

**Table 1—The Effect of Disease on DLCO**

Disease State	DLCO
Airways diseases	
Asthma	Normal†
Chronic bronchitis	Normal
Emphysema	Low
Bronchiectasis	Low
Interstitial lung diseases	
Idiopathic pulmonary fibrosis	Low
Pulmonary involvement in collagen-vascular diseases	Low
Sarcoidosis	Low (stage II, III)
Drug-induced lung disease	Low
Diseases of pulmonary vasculature	
Pulmonary embolic disease	Low
Pulmonary vasculitis	Low
Pulmonary hemorrhage	High
Extrapulmonary diseases	
Respiratory muscle weakness	Low
Kyphoscoliosis	Low
Obesity	Normal†
Polycythemia	High

\*Adapted from ATS/ERS.<sup>17</sup>

†High values have also been reported.

**Table 2—Severity Assessment of a Reduced DLCO\***

Degree of Severity	DLCO, % Predicted
Mild	> 60 and less than lower limit of normal
Moderate	40–60
Severe	< 40

\*Adapted from ATS/ERS.<sup>17</sup>

#### MEASUREMENT AND UTILIZATION OF VOLUME-CORRECTED DIFFUSION CAPACITY

The use of the alveolar volume (VA) determined during the measurement of the single-breath DLCO to “volume correct” the diffusing capacity (volume-corrected diffusing capacity [DL/VA]) is controversial.<sup>17–19</sup> Marie Krogh<sup>3</sup> believed her data showed that the DLCO was linearly proportional to the VA and that DL/VA was a constant (transfer coefficient [Kco]). Subsequent studies<sup>18–20</sup> have shown that the relationship between DLCO and VA is not linear, and therefore Kco is not a constant. Thus, one cannot “volume correct” the DLCO. It is likely that DLCO reductions greater than VA reductions reflect pulmonary vascular problems. DLCO reductions comparable to VA reductions reflect pulmonary parenchymal problems. DLCO reductions less than VA reductions reflect extrapulmonary problems such as obesity, neuromuscular disease, pleural disease, or resection of pulmonary tissue.<sup>17</sup> The current recommendation is to measure and examine DL/VA and VA separately because they may “provide information on the disease pathophysiology that cannot be obtained from their product, DLCO.”<sup>17</sup>

#### PREDICTION EQUATIONS FOR DLCO

No one set of prediction equations for normal values of the single-breath DLCO has been recommended by the ATS and ERS.<sup>17</sup> The PF laboratory should use predicted values that reflect the patient population seen in the laboratory. Reference values from Crapo and Morris<sup>21</sup> were developed at altitude in Utah using a fraction of inspired oxygen of 0.25 to simulate the pressure of inspired oxygen at sea level. Reference values from Miller and associates<sup>22</sup> were developed in Michigan. Reference values utilizing the DLCO standards suggested by the ATS<sup>12,13</sup> or by the ATS and ERS<sup>11</sup> have not been published. Other reference values have been published from the United States and Europe<sup>17</sup> that may be useful.

#### PRACTICE MANAGEMENT IMPLICATIONS

There is one current procedural terminology (CPT) code available to report DLCO, 94720.<sup>23</sup> If DLCO

measurement occurs in a laboratory not owned by the physician or the physician’s practice, when the physician interprets the test, a “26” modifier should be attached to the code, 94720-26. The PF laboratory should report 94720-TC to bill for the technical charges for performing the test. If the physician or the physician’s practice owns the PF laboratory, then 94720 without a modifier should be reported when billing for the test. The full code includes both the interpretive and technical components. When billing for other PF tests measured at the same setting as the DLCO, no modifiers are required. No correct coding initiative edits exist between the DLCO and the other PF codes.<sup>24</sup> If the physician performs an evaluation and management service on the same day as the physician interprets the DLCO or any other PF test, no “25” modifier is required on the evaluation and management code.<sup>25</sup>

CPT code 94720 must be linked with an International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnostic code that is appropriate to support medical necessity for measuring the DLCO in the patient. Medicare allows the use of certain ICD-9-CM codes to document medical necessity through local carrier determinations.<sup>26</sup> Thus, allowable codes may vary across the country, so the physician should be familiar with those codes allowed by the local carrier. Most of the commonly used pulmonary or pulmonary symptom ICD-9-CM codes can be listed to substantiate medical necessity.<sup>27</sup> One notable exception is that cystic fibrosis with pulmonary involvement, 277.02, is not listed as a code substantiating medical necessity for ordering a DLCO test nor for ordering any other PF test.<sup>26</sup> When billing other payers for 94720, these payers should be asked what documentation is necessary to substantiate medical necessity.

CPT code 94725, referred to as the *membrane diffusing capacity*, can be used to report the measurement of the components of DLCO, the DMCO, and  $\theta Vc$ .<sup>23</sup> No clinical value has been established for this test. However, Medicare claims for 94725 have risen from 7,941 tests in 2000 to 87,496 tests in 2005,<sup>28</sup> an enormous increase of > 1,000% over that 5-year interval. The places of service for these tests were in physicians’ offices (97.18%), in the home (2.63%), in custodial care (0.16%), and in nursing homes (0.04%).<sup>28</sup> The majority of tests were reported from independent diagnostic testing centers (59.47%). General practitioners (13.24%) and family practitioners (9.66%) made up most of the rest of the reporting practices. Only 4.56% of the tests were reported from pulmonologists. It is difficult to justify the measurement of the membrane diffusing capacity in the PF laboratory, let alone in the home, under custodial care, or in a nursing home.

Why has the utilization of 94725 increased so much since clinical utility has yet to be established for the test? Only an investigation will be able to answer that question. There are a number of possible explanations. The number of DLCO tests performed in the Medicare population has increased from 491,638 in 2000 to 846,482 in 2005,<sup>28</sup> a 72% increase in utilization. This indicates that physicians feel the DLCO has importance in the evaluation of their patients. The increase in 94725 also follows this pattern and may indicate a legitimate increase. However, the rate of increase for 94725 is nearly 14-times higher than that for 94720. Another possibility is that there has been miscoding of 94720 to 94725. If this is true, it is not clear why so many would suddenly be making coding errors. The most likely explanation is that there is a significant financial incentive to use 94725. The reimbursement for 94725 is 1.45 relative value units higher per test than 94720 (an increase of about \$55 per test).<sup>29</sup> For 2005, this resulted in payments of over \$4.8 million above what would have been paid for 94720. It seems reasonable to propose that coding and billing for the membrane diffusing capacity, 94725, be stopped until the clinical indications for its use have been established. Those who code and bill for 94725 must be prepared to justify the use of this code to Medicare and other third-party payers.

#### CONCLUSIONS

DLCO measured for clinical and research purposes almost exclusively by the single-breath method is an important and very useful PF test. It is helpful in the evaluation of patients with dyspnea, obstructive lung diseases, restrictive lung diseases, with or without pulmonary parenchymal involvement, and in patients with pulmonary vascular diseases. DLCO reflects the surface area available, the volume of blood present in the pulmonary capillaries, as well as the thickness of the alveolar capillary membrane. Because of interlaboratory variability in measuring the diffusing capacity, a number of statements recommending standardization of the DLCO by the ATS and ERS have been published to reduce this variability. The use of DLVA is controversial and not currently recommended because the basic assumption that DLVA is a constant ( $K_{co}$ ) has been disproved. Normal predictive equations for DLCO exist from studies in the United States and Europe, but no recommendation for which values to use has been offered from ATS and ERS. The CPT code for billing of DLCO is 94720. The number of DLCO tests performed in the Medicare population continues to rise every year. The CPT code for billing of mem-

brane diffusing capacity is 94725. There has been no value established for its use in clinical medicine. The utilization of 94725 is excessive and is increasing at a rate nearly 14-times higher than the rate of rise in the utilization of the DLCO. The most likely reason for this excess is the financial gain derived from coding and billing 94725. It is proposed that coding and billing for membrane diffusing capacity be stopped until the clinical indications for its use have been established. Those who code and bill for 94725 must be prepared to justify the use of this code to Medicare and third-party payers.

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