

Technical Documentation for DLL Version 4.01 for the CMG Classification System Version 4.01

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This documentation is for a revised version of the CMG dynamic-link library (DLL) for use in classifying patients in Inpatient Rehabilitation Facilities (IRFs). This revision represents a new version 4.01 of the CMG classification system with the DLL version also being 4.01. This new version applies to assessments with discharge date on or after April 1, 2020. For a description of the changes with version 4.01 see the "Changes with CMG and DLL Versions 4.01" section later in this document.

Note that version 4.01 of the DLL is backwardly compatible with prior versions 2.40, 2.50, 2.60, 2.70, 2.82, 2.90, 3.00, 3.10 and 4.00, and it will calculate the CMG group code for all IRF-PAI assessments with discharge date on or after 7/1/2010.

This documentation and the CMG DLL are published by the Centers for Medicare & Medicaid Services (CMS). The documentation and DLL may be copied freely, as our goal is broad dissemination to facilitate accurate classification of Inpatient Rehabilitation Facility (IRF) patients with the Case Mix Group (CMG) classification system.

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Introduction

This documentation describes a DLL that can be used to calculate a patient's CMG group from Inpatient Rehabilitation Facility Patient Assessment Instrument (IRF-PAI) data. The CMG 4.01 DLL is a 32-bit DLL that can be called from Visual Basic or from C++ applications. The DLL can accept any of the following inputs:

- (1) a string containing an IRF-PAI data record in the standard CMS fixed-length string format
- (2) a string containing an IRF-PAI data record in the standard CMS XML submission format
- (3) a string containing the filename of a standard CMS XML submission file.

It returns the CMG value and associated information. Documentation for the IRF-PAI standard XML and fixed-length string submission formats, as well as the DLL and associated documentation, is available at:

<http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/InpatientRehabFacPPS/Software.html>

The ZIP file (CMG_4.01.ZIP) containing the DLL software and documentation may be freely distributed and you may freely use and distribute the DLL in your applications.

Later sections of this document (1) describe the input and output parameters used when calling the DLL, (2) the error codes that are returned by the DLL, and (3) IRF-PAI assessment test data with correct CMG values included.

Changes with CMG and DLL Versions 4.01

The prior CMG and DLL Versions were both 4.00, allowing processing of IRF-PAI assessments with discharge date on or after 10/1/2019. There is one processing change with Version 4.01. One single ICD-10-CM code, U07.1, assigning Tier 3 (D) was added. The added code is indicated in Appendix C the “Comorbidity Tier Code Lookup Table.”

Versioning

There are two separate version designators related to the DLL. The first is the version of the CMG classification model. The new version of the CMG model has been designated by CMS as version 4.01 and this version is based on the April 1, 2020 addition of U07.1 as a valid ICD-10 code. The new model is implemented in the DLL that is named CMG_401.DLL to indicate that it computes the version 4.01 model. The class implemented by the DLL is named CMG_401, and the property sCmgVersion which is returned by the DLL has a value of “4.01”. The name of the DLL, the class, and the CmgVersion will not change unless CMS publishes a new regulation containing a new CMG model.

The DLL also has its own internal version number which can be different than the CMG model version number. The DLL version number is initially set the same as the CMG model version number. Thus, this initial version of CMG_401.DLL has a DLL version number of “4.01” (available from the sDLLVersion property). If the DLL for CMG model version 4.01 is later corrected or revised, then a new DLL version number will be used (e.g., “4.02”). However, regardless of the DLL version number, the name of the DLL and of the class that calculates version 4.01 of the CMG model will be CMG_401.

Contents of the CMG_401.ZIP File

The CMG_401.ZIP file contains the following files:

1. **Technical Documentation.pdf** -- The current document, which explains the use of the DLL.
2. **Program Documentation.pdf** -- Explains how to calculate CMG group codes. This document is primarily for programmers who wish to write their own CMG calculation software rather than using the DLL. Programmers who wish to use the DLL do not need to read this document to use the DLL correctly.
3. **CMG DLL.ZIP** – a zip file containing:
 - CMG_401.h
C++ code defining RIC, CMG group, and comorbidity tier lookup table code (Windows and UNIX)
 - CMG_401.cpp
C++ code containing the CMG classification logic (Windows and UNIX)
 - **Windows DLL Files**
 - CMG_401.DLL
The 32-bit DLL that performs CMG classification
 - CMG_401.exp
DLL support file
 - CMG_401.lib
DLL support file
 - **UNIX Shared Object Files:**
 - Libcmg401proc.so
Shared Object file that performs CMG classification
 - Cmg401proc.cpp
The CPP code calling the CMG grouper for UNIX

— Makefile
Shared Object support file

4. **Standard Test Data.ZIP** – This ZIP file contains standard test data for testing applications using the DLL or Shared Object provided in the CMG package. The DLL and Shared Object have been extensively tested for calculation of the motor score, cognitive score, and age; correct RIC lookup for all impairment codes at admission (Item 21A); correct CMG group lookup; and correct comorbidity tier assignment for each single comorbidity code and code combination (always a pair of codes in this version). The standard version 4.01 test data address all of these calculations.

The Standard Test Data Zip file contains the following:

- **Cmg1F17 v7.txt** – a text file with 1,003 IRF-PAI assessment test records in the IRF-PAI standard fixed record format, testing CMG group number assignment. All records have discharge date in April 2020.
- **CM1F17 v7.zip** – a ZIP file containing 1,003 test files in standard XML submission format, testing CMG group number assignment. All files have discharge date in April 2020.
- **CmrTest1 4_01 v6.txt** – a text file with 2,127 IRF-PAI assessment test records in the IRF-PAI standard fixed record format, testing comorbidity tier assignment. All records have discharge date in April 2020.
- **CmrTest1 4_01 v6.zip** -- a ZIP file containing 2,127 test files in standard XML submission format, testing comorbidity tier assignment. All files have discharge date in April 2020.
- **MCaf17 v5.txt** -- a text file with 169 IRF-PAI assessment test records in the IRF-PAI standard fixed record format, testing motor score, cognitive score, and age calculation. All records have discharge date in April 2020.
- **MCaf17 v5.zip** -- a ZIP file containing 169 test files in standard XML submission format, testing motor score, cognitive score, and age calculation. All files have discharge date in April 2020.
- **Cmr1 F16F17 v6.txt** -- a text file with 16 IRF-PAI assessment test records in the IRF-PAI standard fixed record format, testing previously added comorbidity codes with version 4.01. Records have discharge date in either October 2019 or April 2020.
- **Cmr1 F16F17 v6.zip** – a ZIP file containing 16 test files in standard XML submission format, testing previously added comorbidity codes with version 4.01. Files have discharge date in either October 2019 or April 2020.
- **motortestv2.txt** -- a text file with 87 IRF-PAI assessment test records in the IRF-PAI standard fixed record format, testing the possible motor score combinations with version 4.01. Records have discharge date in April 2020.
- **motortest v2.zip** – a ZIP file containing 87 test files in standard XML submission format, testing the possible motor score combinations with version 4.01. Files have discharge date in April 2020.
- **U071 test.txt** -- a text file with 2 IRF-PAI assessment test records in the IRF-PAI standard fixed record format, testing the addition of ICD-10 code U07.1 with version 4.01. One record has discharge date prior to April 1, 2020, and the other has a discharge date after April 1, 2020.
- **U071 test.zip** – a ZIP file containing 2 test files in standard XML submission format, testing the addition of ICD-10 code U07.1 with version 4.01. One record has discharge date prior to April 1, 2020, and the other has a discharge date after April 1, 2020.

The known, correct CMG results in the “txt” test data files are located in the standard fixed record as follows:

KNOWN RESULT	START BYTE	END BYTE	FORMAT
Motor Score	2285	2289	Right Justified
Cognitive Score	2290	2294	Right Justified
Age	2282	2284	Right Justified
CMG group code	2138	2147	Left Justified

The known, correct CMG result in the XML test data files is the CMG group code in the SBMTD_CMG_TXT tag.

Developing CMG Applications

The C++ source code illustrates how to call and use the DLL or Shared Object from C++ and should serve as a model for developing C++ applications and applications in other languages. For applications using the DLL or Shared Object, it is sufficient to use the standard test data.

For applications rewriting CMG from scratch, custom test data should be developed and used, in addition to the standard test data. The custom test data should test all CMG calculations, including calculation of the motor score, cognitive score, and age; correct RIC lookup for all impairment codes at admission (Item 21A); correct CMG group lookup; and correct comorbidity tier assignment for each single comorbidity code and code combination (always a pair of codes in this version).

Parameters Used by the DLL or Shared Object

Note that the parameters listed below correspond exactly with properties. You must “set” the properties listed as input parameters, and “get” the properties listed as output parameters.

Parameter Name	Parameter Type	Data Type	Description
sIrfRecord	Input	String	A string containing the IRF-PAI record in standard CMS format (length=2785 bytes with a “%” character in the last byte). For use with the CMG_401 method only.
sXMLRecord	Input	String	A string containing the IRF-PAI record in standard CMS XML submission format. For use with the CMG_401_XML method only.
sFileName	Input	String	The filename of a file containing an assessment in standard CMS XML submission format. For use with the CMG_401_XML_FILE method only.
sCmgValue	Output	String	CmgValue is a 5-byte string containing the CMG group. If no value has been calculated or the ErrorCode property is non-zero, CmgValue will contain 5 spaces.
iErrorCode	Output	Integer or Long ¹	If ErrorCode is equal to zero, no errors occurred and CmgValue will contain a valid CMG group designation. If an error occurred, ErrorCode will be non-zero and CmgValue will contain 5 spaces. The possible values of ErrorCode are listed in a later section of this document.

¹ The data type of the function return value is “integer” in C++ and “long” in Visual Basic .NET and Visual Basic 6 programs that call the DLL.

Parameter Name	Parameter Type	Data Type	Description
sMotorScore	Output	String	Calculated CMG motor score. For assessments with discharge date prior to 10/01/2019: If ErrorCode is equal to zero, the value of Motor will be between 12.0 and 84.0, otherwise Motor will be equal to zero. For assessments with discharge date on or after 10/01/2019: If ErrorCode is equal to zero, the value of Motor will be between 18.0 and 104.0, otherwise Motor will be equal to zero.
iCognitive	Output	Integer or Long ¹	Calculated CMG cognitive score. For assessments with discharge date prior to 10/01/2019: If ErrorCode is equal to zero, the value of Cognitive will be between 5 and 35, otherwise Cognitive will be equal to zero. For assessments with discharge date on or after 10/01/2019: Cognitive will be equal to zero.
iAge	Output	Integer or Long ¹	Calculated age (computed by comparing date of birth with date of admission). If ErrorCode is equal to zero, the value of age will be between 0 and 140, otherwise Age will be equal to zero.
sCmgVersion	Output	String	CmgVersion is a string which returns a value of "4.01", the version number of the present CMG calculation model.
sDllVersion	Output	String	DllVersion is a string which returns a value of "4.01", the version number for the present DLL.

Error Codes

The DLL returns the value for iErrorCode. If no errors are detected by the DLL, the iErrorCode value is returned as zero and a non-blank sCmgValue (calculated CMG group code) is returned. If errors are detected, iErrorCode is returns a non-zero value (indicating the error found) and sCmgValue is returned as 5 spaces. Your code should always check the value of iErrorCode after every call to CmgValue.

Note that the DLL does not check to insure that the IRF-PAI assessment record complies with the standard data specifications requirements. It is therefore possible for the DLL to return a valid CMG value from an IRF-PAI record that is not compliant and would be rejected by the standard CMS IRF-PAI system.

The values returned in iErrorCode are as follows:

iErrorCode = 0

No errors found.

iErrorCode = 1

Not an IRF-PAI record, as indicated by ASMT_SYS_CD not equal to 'IRF-PAI'.

iErrorCode = 2

The record is a request to inactivate a CMS database assessment rather than an IRF-PAI assessment record. Request to inactivate is indicated by TRANS_TYPE_CD = 3.

iErrorCode = 3

The discharge date (Item 40) is before 7/1/2010 and CMG does not support calculation for this record.

iErrorCode = 5

The year of a partial birthdate (Item 6) equals the year of admission (Item 12).

iErrorCode = 6

The admission date (Item 12) is before the birthdate (Item 6).

iErrorCode = 7

The patient age [based on admission date (Item 12) and birthdate (Item 6)] is greater than 140.

iErrorCode = 9

The admission impairment group code (Item 21A) is not a valid value.

DLL Version History

The DLL version number is returned by the DllVersion parameter described earlier in this documentation.

Version	Comments
Beta 01	Initial beta release.
Beta 02	Second beta release.
Beta 03	Third beta release.
Beta 04	Fourth beta release.
Beta 05	Fifth beta release.
Beta 06	Not released.
Beta 07	Seventh beta release. Posted on CMS website on 10/2001.
1.10	Second public version of the DLL, posted on CMS website on 6/2002.
1.20	Third public version of the DLL, released in July 2004.
1.21	Internal release – not publicly distributed.
1.22	Fourth public version of the DLL, released in December 2004.
2.00	Fifth public version of the DLL, released August 2005. Implements the second version (Version 2.00) of the CMG classification system.
2.01	Sixth public version of the DLL, released August, 2005. The only change with DLL Version 2.01 was to fix a problem in DLL Version 2.00 that prevented an application from loading DLL Version 2.00 and a prior version (e.g., Version 1.22) simultaneously in a Visual Basic 6 application.
2.02	Seventh public version of the DLL, released March, 2006. Removed one comorbidity that had been included in DLL Version 2.00.
2.10	Eighth public version of the DLL, released August, 2006. Many comorbidities were added, deleted, or changed tiers per the FY 2007 IRF PPS Final Rule due to be published on August 1, 2007 and the FY 2007 annual revision to the ICD9 codes.
2.20	Ninth public version of the DLL, released August, 2007. Several comorbidities were added and 2 comorbidities were deleted per the FY 2008 annual revision to the ICD9 codes.
2.30	Tenth public version of the DLL, released August, 2008. Several comorbidities were added and 1 comorbidity was deleted per the FY 2009 annual revision to the ICD9 codes.
2.40	Eleventh public version of the DLL, released August, 2009. Four comorbidities were added and 1 comorbidity was deleted per the FY 2010 annual revision to the ICD9 codes.
2.50	Twelfth public version of the DLL, released August, 2010. Seven comorbidities were added and two comorbidities were deleted per the FY 2011 annual revision to the ICD9 codes.
2.60	Thirteenth public version of the DLL, released August, 2011. Nineteen comorbidities were added, three comorbidities were deleted, and four comorbidities had label changes per the FY 2011 annual revision to the ICD9 codes.
2.70	Fourteenth public version of the DLL, released July, 2014. The only change was the use of the 25 comorbidity items implemented in the IRF-PAI assessment for October 1, 2014.

Version	Comments
2.80	Fifteenth public version of the DLL, released August, 2015. The only major change was the shift from ICD-9-CM diagnosis codes to ICD-10-CM codes in the IRF-PAI assessment for October 1, 2015.
2.81	Sixteenth public version of the DLL, released January, 2016. The only change was revision of comorbidity handling to correct a flaw that occurred with the prior Version 2.80 for some IRF-PAI assessment records.
2.82	Seventeenth public version of the DLL, released May 22, 2016. The only change was correction of a comorbidity handling flaw in Version 2.81 for older IRF-PAI assessments with discharge date before 10/1/2015.
2.90	Eighteenth public version of the DLL, released August, 2016. One hundred and ninety-nine comorbidities were added and 45 comorbidities were deleted per the FY 2017 annual revision to the ICD-10-CM codes.
3.00	Nineteenth public version of the DLL, released August 2017. Five comorbidities were added and two comorbidities were deleted per the FY 2018 annual revision to the ICD-10-CM codes. The DLL was enhanced to allow processing of either the IRF-PAI standard XML submission format or the fixed-length string format.
3.10	Twentieth public version of the DLL, released August 2018. Eleven comorbidities were added and three comorbidities were deleted per the FY 2019 annual revision to the ICD-10-CM codes.
4.00	Twenty-first public version of the DLL, released September 2019. The calculation of the motor score is different for assessments with discharge date 10/01/2019 and later. The cognitive score is no longer calculated for assessments with discharge date 10/01/2019 and later. Two single ICD-10-CM codes assigning Tier 3 (D) were added, and two label changes were made per the FY 2020 annual revision to the ICD-10-CM codes. .
4.01	Twenty-second public version of the DLL, released April 2020. A single ICD-10-CM code, U07.1, assigning Tier 3 (D) was added.

Technical Assistance

If you have questions about the DLL which are not answered by this documentation, please refer to the CMS web site for further information or for contact information to receive assistance:

<http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/InpatientRehabFacPPS/Software.html>