

CS580 Term Project, Final Report

Integration of Two Psychiatric Databases

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I. Introduction

1. Project resource

This term project is assigned by Professor Clement Yu from the course of CS580. Professor Neil Smalheiser from the Psychiatric Institute provided the original schemas of the 2 databases, which are to be analyzed. Two books, “Diagnostic and Statistical Manual of Mental Disorders” Third Edition and Fourth Edition, are used as the source background information for the Bipolar Disorders.

2. Research goal

These two databases come from two different research groups, both of who had carried out research work on Bipolar Disorders individually. They had collected much historic data from the patients. The goal of the project is to design a global schema and proper resolution functions for the integration of two psychiatric databases. Design proper processing strategies to process some typical queries.

3. Contents of this report

Based on our understanding of the Bipolar Disorders and the schema of the two Psychiatric Databases, This report uses the databases integration knowledge, to design a global schema for the queries on both of the two databases.

In part 1, background information about the project is provided.

In part 2, necessary information about the Bipolar Disorders is introduced.

In part 3, the two databases are studied. Inconsistencies among them are pointed out and analyzed.

In part 4, we list all possible conversions from IIR Bipolar Disorders to IV Bipolar Disorders.

In part 5, the global schema for the integration of the above two databases is designed.

In part 6, a query example is provided to illustrate how to carry out query on the global schema and get results from the two databases.

In Part 7, we make conclusion on our work.

II. IIR and IV Bipolar disorders classification

1. Bipolar disorders

(1) IIR bipolar disorders

According to the book of IIR, there are 3 kinds of Bipolar disorders. And the “Bipolar Disorder” can be classified again to 3 different sub-type disorders. They are:

Bipolar Disorder (including)

296.6x Bipolar Disorder, Mixed

296.4x Bipolar Disorder, Manic

296.5x Bipolar Disorder, Depressed
 301.13 Cyclothymia
 296.70 Bipolar Disorder Not Otherwise Specified

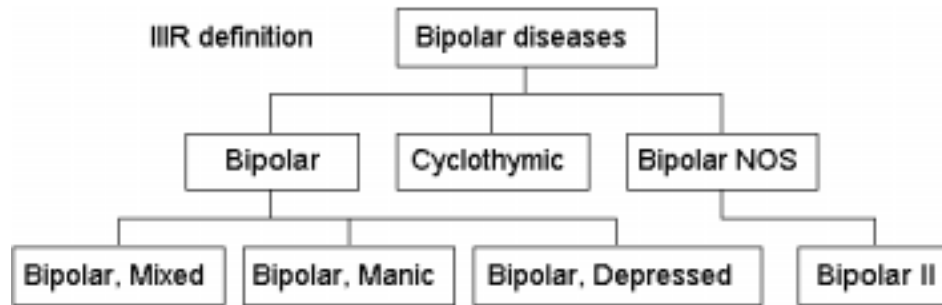


Figure 1.1 Hierarchy of the IIR Bipolar disease

The details about their criteria can be found in Appendix 3

(2) IV bipolar disorders

According to the book of IV, there are 4 kinds of Bipolar disorders. And the “Bipolar Disorder I” can be classified again to 6 different sub-type disorders. They are:

Bipolar I Disorder (including)

296.0x Bipolar I Disorder, Single Manic Episode

296.40 Bipolar I Disorder, Most Recent Episode Hypomanic

296.4x Bipolar I Disorder, Most Recent Episode Manic

296.6x Bipolar I Disorder, Most Recent Episode Mixed

296.5x Bipolar I Disorder, Most Recent Episode Depressed

296.7 Bipolar I Disorder, Most Recent Episode Unspecified

296.89 Bipolar II disorder

301.13 Cyclothymic Disorder

296.80 Bipolar Disorder Not Otherwise Specified

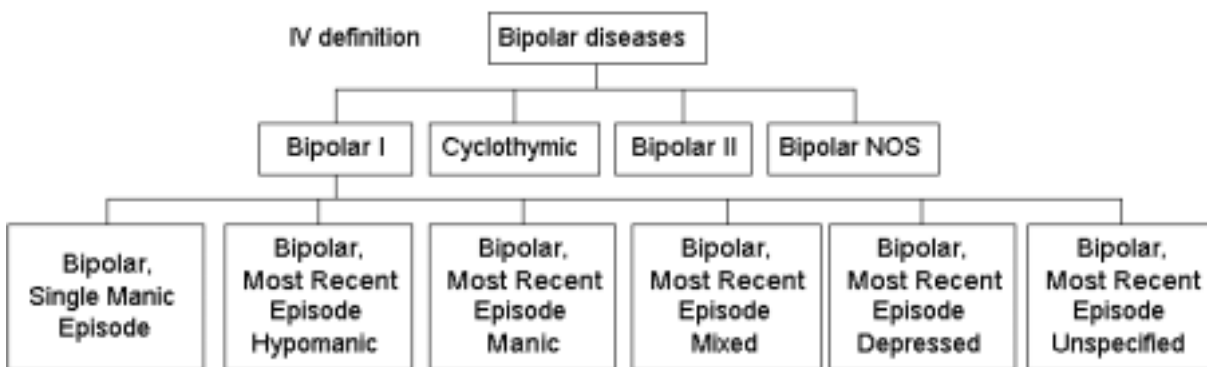


Figure 1.2 Hierarchy of the IV Bipolar disease

The details about their criteria can be found in Appendix 3

2. Episodes and symptoms

Each bipolar disorder can be defined as a set of certain symptoms, e.g. symptoms 1, 2, 3, etc. Further more, some symptoms can be described as “Episodes”, e.g. episode X consists of symptoms a, b, and c. And then, the criteria of bipolar disorder can be described as a set of certain Episodes, e.g. Bipolar X consists of Episodes A, B, C, etc.

There are 3 types of Episodes in IIR and 4 types in IV. In IIR, they are Manic Episode, Major Depressive Episode, and Hypomanic Episode. In IV, the other one is Mixed Episode.

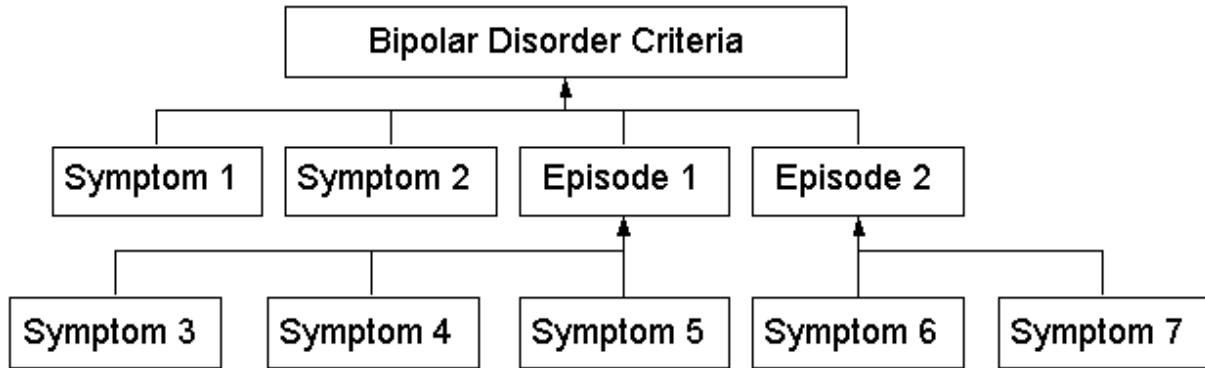


Figure 2.1 Criteria Hierarchy

The Episodes do not have their own diagnostic codes and cannot be diagnosed as separate entities. They consist of certain symptoms and serve as part of the Bipolar Disease diagnoses. The criteria sets for most of the Mood Disorders require the presence or absence of the mood episodes. For example, in IIR, the point A of the Bipolar, Mixed criteria is “...involves the full symptomatic picture of both Manic and Major Depressive Episodes...” There are 3 types of Episodes in IIR definition and 4 types in IV

The details about the Episodes definition can be found in Appendix 2

3. IIR to IV Disorder conversion

In this part, we try to build up relationship between IIR Bipolar Disorders with corresponding IV Bipolar Disorders. Based on their diagnostic criteria, we find several possible conversions. The global queries about disorders conversion can be solved based on the relationship in this part.

Symbol definition: For each of the disorders, we use the term of TYPE-criteria-X to refer to a symptom description in the definition of that disorder. TYPE is either IIR or IV. While X can be A, B, C, etc. X refers to the symptom mark. For example, for the Bipolar II, IIR-criteria-B is the criteria point B of the IIR Bipolar II definition.

All symptom descriptions are from the book IIR and IV. For the detailed description of these Episodes, please refer to appendix 2 and appendix 3.

(1) Episodes conversion from IIR to IV

Manic Episode

IIR-criteria-A + “at least a week long time” = IV-criteria-A

IIR-criteria-B-n (n = 1..7) = IV-criteria-B-n (n = 1..7)

IIR-criteria-C = IV-criteria-D

IIR-criteria-D: no related symptom in IV. But this does not influence the conversion

IIR-criteria-E: no related symptom in IV. Required by IV-B-I, IV-B-II, and IV-Cyclothymic

IIR-criteria-F = IV-criteria-E and IV-criteria-Note

IV-criteria-C: no related symptom in IIR. But this does not influence the conversion

Conclusion: IIR Manic + IIR-criteria-A lasts at least a week + IV-criteria-C = IV Manic

Hypomanic Episode

In IIR, Hypomanic Episode is a true sub-set of the Manic Episode. So here we still use the descriptions from IIR Manic Episode definition. But there is a separate definition for it in IV.

IIR, Hypomanic Episode = IIR Manic Episode other than IIR-criteria-C

IIR-criteria-A + “at least 4 days” = IV-criteria-A

IIR-criteria-B-n (n = 1..7) = IV-criteria-B-n (n = 1..7)

IIR-criteria-D: no related symptom in IV. But this does not influence the conversion

IIR-criteria-E: no related symptom in IV. Required by IV-B-I, IV-B-II, and IV-Cyclothymic

IIR-criteria-F = IV-criteria-F and IV-criteria-Note

IV-criteria-C: no related symptom in IIR. But this does not influence the conversion

IV-criteria-D: no related symptom in IIR. But this does not influence the conversion

IV-criteria-E: no related symptom in IIR. But this does not influence the conversion

Conclusion: IIR Hypomanic + IIR-criteria-A lasts at least 4 days

+ IV-criteria-C + IV-criteria-D + IV-criteria-E = IV Hypomanic

Major Depressive Episode

IIR-criteria-A-n (n = 1..9) = IV-criteria-A-n (n = 1..9)

IIR-criteria-B-1 = IV-criteria-D

IIR-criteria-B-2 = IV-criteria-E

IIR-criteria-C: no related symptom in IV. But this does not influence the conversion

IIR-criteria-D: no related symptom in IV. Required by IV-B-I, IV-B-II, and IV-Cyclothymic

IV-criteria-B: no related symptom in IIR. But this does not influence the conversion

IV-criteria-C: no related symptom in IIR. But this does not influence the conversion

Conclusion: IIR Major Depressive + IV-criteria-B + IV-criteria-C = IV Major Depressive

Mixed Episode

There has no definition for Mixed episode in IIR. So we just use its definition in IV

Conclusion: IV Mixed = IV-criteria-A, IV-criteria-B, IV-criteria-C

(2) Diseases conversion from IIR to IV

IIR Bipolar II → IV Bipolar II

IIR definition = IV-criteria-A + IV-criteria-B + IV-criteria-C

IV-criteria-D = IIR-Hypomanic-Episode-criteria-E

There are no related descriptions for IV-criteria-E in IIR

Conclusion: IIR definition + IV-criteria-E = IV definition

IIR Cyclothymia → IV Cyclothymic

IIIR-criteria-A = IV-criteria-A
IIIR-criteria-B = IV-criteria-B
IIIR-criteria-C = IV-criteria-C
IIIR-criteria-D = IV-criteria-D
IIIR-criteria-E = IV-criteria-E
IV-criteria-F: no related description in IIIR
Conclusion: IIIR definition + IV-criteria-F = IV definition

IIIR Bipolar, Mixed → IV Bipolar I, Most Recent Episode Mixed
IIIR-criteria-A = IV-criteria-A
IIIR-criteria-B: no related description in IV. But this does not influence the conversion
IV-criteria-B: no related description in IIIR
IV-criteria-C: IIIR-manic-Episode-criteria-E (= IIIR-major-depressive-Episode-criteria-D)
Conclusion: IIIR definition + IV-criteria-B = IV definition

III Bipolar, Depressed → IV Bipolar I, Most Recent Episode Depressed
IIIR-criteria-A = IV-criteria-B
IIIR-criteria-B = IV-criteria-A
IV-criteria-C: IIIR-manic-Episode-criteria-E (= IIIR-major-depressive-Episode-criteria-D)
Conclusion: IIIR definition = IV definition

III Bipolar, Manic → IV Bipolar I, Single Manic Episode
IIIR definition is part of the IV-criteria-A
IV-criteria-B: IIIR-manic-Episode-criteria-E (= IIIR-major-depressive-Episode-criteria-D)
Conclusion: IIIR definition + “no past Major Depressive Episode” = IV definition

III Bipolar, Manic → IV Bipolar I, Most Recent Episode Manic
IIIR definition = IV-criteria-A
IV-criteria-B: no related descriptions in IIIR
IV-criteria-C: IIIR-manic-Episode-criteria-E (= IIIR-major-depressive-Episode-criteria-D)
Conclusion: IIIR definition + IV-criteria-B = IV definition

IV Bipolar I, Most Recent Episode Hypomanic
No related definition in IIIR. We can only confirm this type by IV definition itself.

Bipolar I, Most Recent Episode Unspecified
No related definition in IIIR. We can only confirm this type by IV definition itself.

IIIR Bipolar NOS → IV Bipolar NOS
IIIR Bipolar NOS (2) → IV Bipolar NOS (2)
IIIR Bipolar NOS (3) → IV Bipolar NOS (3)

IIIR Bipolar NOS → IV Bipolar I, Hypomanic
IIIR Bipolar NOS → IV Bipolar I, Most Recent Episode Unspecified

The definitions for both IIIR Bipolar NOS and IV Bipolar NOS are too short to build up a clear conversion. And we are also not sure if IIIR Bipolar NOS, under certain circumstances, can be converted to IV Bipolar I, hypomanic or IV Bipolar I, Unspecified.

III. Analysis of two existing databases

1. Tables from two databases

In the two databases, there are four pairs of tables, each pair of which concerns the same symptoms.. These tables are SAPS and SAPS_SWEENEY; SANS and SANS_SWEENEY; BPRS and BPRS_SWEENEY; HAMILTON and HAM_ANX_ SWEENEY. One of our research goals is to identify the attributes in common and those that are not in common among these tables.

The patients in two databases are completely independent. No patient belongs to both of them. So there is no data inconsistency between the tables. What we should be aware is that given a symptom, we should use different attributes in different databases to map it.

2. Symptom → attribute(s) conversion

In the global schema, we need a relation to hold the relationship between a symptom and its corresponded attributes. Because there are 2 databases, there are some symptoms that have at least 2 related attributes, one of which is from DB1 and the other one of which is from DB2.

We find the following attributes:

	Symptoms	Attributes in DB 1	Attributes in DB 2
A	elevated expansive	BPRS.17_Excitement BPRS.8_Grandiosity	BPRS_sweeney.excite BPRS_sweeney.elated
	Irritable	SAPS.23_Aggress	SAPS_Sweeney.agrbeha
B1	Inflated self-esteem or grandiosity	SAPS.11_Grandiose BPRS.8_Grandiosity	BPRS_Sweeney.grand
B2	Decreased need for sleep	HAMILTON.I4 HAMILTON.I5 HAMILTON.I6	HAM_ANX_Sweeney.sleep
B3	More talkative than usual or pressure to keep talking	SAPS.31_Pressure	SAPS_Sweeney.prspch
B4	Flight of ideas or subjective experience that thoughts are racing	BPRS.15_Unusualthght SAPS.17_ThoughtBr	BPSR_Sweeney.thgtcon SAPS_Sweeney.thgtbr
B5	Distractibility, i.e., attention too easily drawn to unimportant or irrelevant external stimuli	SANS.Avol_IWS SAPS.32_Distractible	SANS_Sweeney.impers SAPS_weeney.disspch
B6	Increase in goal-directed activity or psychomotor agitation	SANS.Anhed_SIA SAPS.22_SocialSex	SANS_Sweeney.sexual SAPS_Sweeney.socbeha
B7	Excessive involvement in pleasurable activities which have a high potential for painful consequences	SAPS.22_SocialSex SAPS.23_Aggress	SAPS_Sweeney.socbeha SAPS_Sweeney.agrbeha
C	Mood disturbance sufficiently severe to cause marked impairment in occupational functioning or in usual social activities or relationships with others, or to necessitate hospitalization to prevent harm to self or others	BPRS.10_Hostility SAPS.25_GlobalRat	BPRS_Sweeney.hostil SAPS_Sweeney.agrbeha
D	At no time during the disturbance have there been delusions or hallucinations for as long as two weeks in the absence of prominent mood symptoms	TRUE (default)	TRUE (default)
E	Not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS	TRUE (default)	Scid_onset.psydis1
F	It cannot be established that an organic factor initiated and maintained the disturbance	TRUE (default)	Scid_onset.psysub1

Table 3.1 Mapping of IIR Manic Episode

	Symptoms	Attributes in DB 1	Attributes in DB 2
A1	Depressed mood most of the day, nearly every day. In children and adolescents, can be irritable mood.	BPRS.9_Depressive HAMILTON.I1	BPRS_Sweeney.depress HAM_ANX_Sweeney.depress
A2	Markedly diminished interest or pleasure in all, or almost all, activities most of the day, nearly every day	BPRS.3_Emot_Withdr SANS.Anhed_RIA	BPRS_Sweeney.emotion SANS_Sweeney.recrea
A3	Significant weight loss when not dieting or weight gain, or decrease or increase in appetite nearly every day.	HAMILTON.I16A HAMILTON.I16B	
A4	Insomnia or hypersomnia nearly every day	HAMILTON.I4 HAMILTON.I5 HAMILTON.I6	HAM_ANX_Sweeney.sleep
A5	Psychomotor agitation or retardation nearly every day	BPRS.17_Excitement, BPRS.13_MotorRetard BPRS.15_Unusualthght SANS.AFB_AN SANS.Alog_ILOR	BPRS_sweeney.htgtcon BPRS_sweeney.excite SANS_Sweeney.nonresp SANS._Sweeney.latency
A6	Fatigue or loss of energy nearly every day	SANS.Avol_PA SANS.AFB_DSM SANS.AFB_UFE SANS.AFB_PEG	SANS_Sweeney.physan SANS_Sweeney.facexp SANS_Sweeney.spon SANS_Sweeney.gesture
A7	Feelings of worthlessness or excessive or inappropriate (delusional) guilt nearly every day	BPRS.5_Guilt HAMILTON.I24 HAMILTON.I2 SAPS.10_Delusions	BPRS_Sweeney.glt SAPS_Sweeney.guilt
A8	Diminished ability to think or concentrate, or indecisiveness, nearly every day	BPRS.4_ConceptDisorg SANS.Att_SI SANS.Att_IDMST SANS.Att_Global	BPRS_Sweeney.concept SANS_sweeney.socinat ANS_sweeney.inatmen SANS_sweeney.gratten
A9	Recurrent thoughts of death, recurrent suicidal ideation, attempt or plan	BPRS.1_Somatic; HamD.I3	BPRS_Sweeney.somat
B1	It cannot be established that an organic factor initiated and maintained the disturbance	TRUE (default)	Scid_onset.psysub1
B2	The disturbance is not a normal reaction to the death of a loved one	TRUE (default)	TRUE (default)
C	At no time during the disturbance have there been delusions or hallucinations for as long as two weeks in the absence of prominent mood symptoms	TRUE (default)	TRUE (default)
D	Not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS	TRUE (default)	Scid_onset.psydis1

Table 3.2 Mapping of IIR Major Depressive Episode

IV Hypomanic Episode			
	Symptoms	Attributes in DB 1	Attributes in DB 2
A	Elevated,expansive Irritable	BPRS.17_Excitement BPRS.11_Suspiciousness	bprs_Sweeney.elated bprs_Sweeney.excite
	Irritable	SAPS.23_Aggress	SAPS_Sweeney.agrbeha
B1	Inflated self-esteem or grandiosity	SAPS.11_Grandiose BPRS.8_Grandiosity	BPRS_Sweeney.grand
B2	Decreased need for sleep	HamD.14 HamD.15 HamD.16	HAM_ANX_Sweeny.sleep
B3	More talkative than usual or pressure to keep talking	SAPS.31_Pressure	SAPS_Sweeney.prspch
B4	Flight of ideas or subjective experience that thoughts are racing	BPRS.15_Unusualthght SAPS.17_ThoughtBr	BPSR_Sweeney.thgtcon SAPS_Sweeney.thgtbr
B5	Distractibility	SANS.Avol_IWS SAPS.32_Distractible	SANS_Sweeney.impers SAPS_weeney.disspch
B6	Increase in goal-directed activity	SANS.Anhed_SIA SAPS.22_SocialSex	SANS_Sweeney.sexual SAPS_Sweeney.socbeha
B7	Excessive involvement in pleasurable activities that have a high potential for painful consequences	SAPS.22_SocialSex SAPS.23_Aggress	SAPS_Sweeney.socbeha SAPS_Sweeney.agrbeha
C	The episode is associated with an unequivocal change in functioning that is uncharacteristic of the person when not symptomatic	TRUE (default)	TRUE (default)
D	The disturbance in mood and the change in functioning are observable by others	TRUE (default)	TRUE (default)
E	The episode is not severe enough to cause marked impairment or occupational functioning, or to necessitate hospitalization, and there are no psychotic features	BPRS_Sweeney.SEV	TRUE (default)
F	The symptoms are not due to the direct physiological effects of a substance or a general medical condition	TRUE (default)	TRUE (default)

Table 3.3 Mapping of IV Hypomanic Episode

	Symptoms	Attributes in DB 1	Attributes in DB 2
A	Elevated expansive	BPRS.17_Excitement BPRS.8_Grandiosity	BPRS_sweeney.excite BPRS_sweeney.elated
	Irritable	SAPS.23_Aggress	SAPS_Sweeney.agrbeha
B1	Inflated self-esteem or grandiosity	SAPS.11_Grandiose BPRS.8_Grandiosity	BPRS_Sweeney.grand
B2	Decreased need for sleep	HAMILTON.I4 HAMILTON.I5 HAMILTON.I6	HAM_ANX_Sweeney.sleep
B3	More talkative than usual or pressure to keep talking	SAPS.31_Pressure	SAPS_Sweeney.prspch
B4	Flight of ideas or subjective experience that thoughts are racing	BPRS.15_Unusualthght SAPS.17_ThoughtBr	BPSR_Sweeney.thgtcon SAPS_Sweeney.thgtbr
B5	Distractibility	SANS.Avol_IWS SAPS.32_Distractible	SANS_Sweeney.impers SAPS_weeney.disspch
B6	Increase in goal-directed activity	SANS.Anhed_SIA SAPS.22_SocialSex	SANS_Sweeney.sexual SAPS_Sweeney.socbeha
B7	Excessive involvement in pleasurable activities that have a high potential for painful consequences	SAPS.22_SocialSex SAPS.23_Aggress	SAPS_Sweeney.socbeha SAPS_Sweeney.agrbeha
C	The symptoms do not meet criteria for a Mixed Episode	TRUE (default)	TRUE (default)
D	Mood disturbance sufficiently severe to cause marked impairment in occupational functioning or in usual social activities or relationships with others, or to necessitate hospitalization to prevent harm to self or others, or there are psychotic features.	BPRS.10_Hostility SAPS.25_GlobalRat	BPRS_Sweeney.hostil SAPS_Sweeney.agrbeha
E	The symptoms are not due to the direct physiological affects of substance or a general medical condition.	TRUE (default)	TRUE (default)

Table 3.4 Mapping of IV Manic Episode

	Symptoms	Attributes in DB 1	Attributes in DB 2
A1	Depressed mood	BPRS.9_Depressive HAMILTON.I1	BPRS_Sweeney.depress HAM_ANX_Sweeney.depress
A 2	Markedly diminished interest or pleasure	BPRS.3_Emot_Withdr SANS.Anhed_RIA	BPRS_Sweeney.emotion SANS_Sweeney.recrea
A3	Significant weight loss	HAMILTON.I16A HAMILTON.I16B	
	Decrease or increase in appetite	HAMILTON_def.I12	
A4	Insomnia or Hypersomnia	HAMILTON.I4 HAMILTON.I5 HAMILTON.I6	AM_ANX_Sweeney.sleep
A5	Psychomotor agitation Psychomotor retardation	BPRS.17_Excitement, BPRS.13_MotorRetard BPRS.15_Unusualthght SANS.AFB_AN SANS.Alog_ILOR	BPRS_sweeney.htgtcon BPRS_sweeney.excite SANS_Sweeney.nonresp SANS._Sweeney.latency
A6	Fatigue or loss of energy	SANS.Avol_PA SANS.AFB_DSM SANS.AFB_UFE SANS.AFB_PEG	SANS_Sweeney.physan SANS_Sweeney.facexp SANS_Sweeney.spon SANS_Sweeney.gesture
A7	Feelings of worthlessness Excessive or inappropriate guilt	BPRS.5_Guilt HAMILTON.I24 HAMILTON.I2 SAPS.10_Delusions	BPRS_Sweeney.glt SAPS_Sweeney.guilt
A8	Diminished ability to think or concentrate or indecisiveness	BPRS.4_ConceptDisorg SANS.Att_SI SANS.Att_IDMST SANS.Att_Global	BPRS_Sweeney.concept SANS_sweeney.socinat ANS_sweeney.inatmen SANS_sweeney.gratten
A9	Recurrent thoughts of death, recurrent suicidal ideation	BPRS.1_Somatic HamD.I3	BPRS_Sweeney.somat
B	The symptoms do not meet criteria for a Mixed Episode	TRUE (default)	TRUE (default)
C	Clinically significant distress or impairment in social, occupational, or other important areas of functioning.	TRUE (default)	TRUE (default)
D	The symptoms are not due to the direct physiological effects of a substance or a general medical condition	TRUE (default)	TRUE (default)
E	The symptoms are not better accounted for by Bereavement	TRUE (default)	TRUE (default)

Table 3.5 Mapping of IV Major Depressive Episode

	Symptoms	Attributes in DB 1	Attributes in DB 2
A	The criteria are met both for a Manic Episode and for a Major Depressive Episode	Refer to IV Manic Episode and IV Major Depressive Episode	Refer to IV Manic Episode and IV Major Depressive Episode
B	The mood disturbance is sufficiently severe to cause marked impairment in occupational functioning or in usual social activities or relationships with others Psychotic features	HAMILTON_def.I7 SANS.Avol_IWS SANS.Anhed_RFP SANS.Att_SI HAMILTON.I19	HAM_ANX_sweeney_def.behave SANS_sweeney_def.IMPERS SANS_sweeney_def.RELAT SANS_sweeney_def.SOCINAT
C	The symptoms are not due to the direct physiological effects of a substance or a general medical condition	TRUE (default)	TRUE (default)

Table 3.6 Mapping of IV Mixed Episode

IV. Global schema design

1. principles in global schema design

The typical global queries are concerned about the statistics information of the disorders and the patients. As to disorders, we create two tables, **DISORDER** and **SYMPTOM**, to store all the disorders and their corresponding symptoms in IIIR and IV. In order to query from local databases, we establish table **SYM_MAPPING** to map symptoms to the attributes in the database.

As to patients' information, we first create the table **DEMO** that stores all the possible personal features that may be queried. After that, we establish the mapping from the global database to the local databases in table **DEMO_MAPPING**. Figure 4.1 illustrates our global schema and Table 4.1 gives the description of all the tables.

2. global schema structures

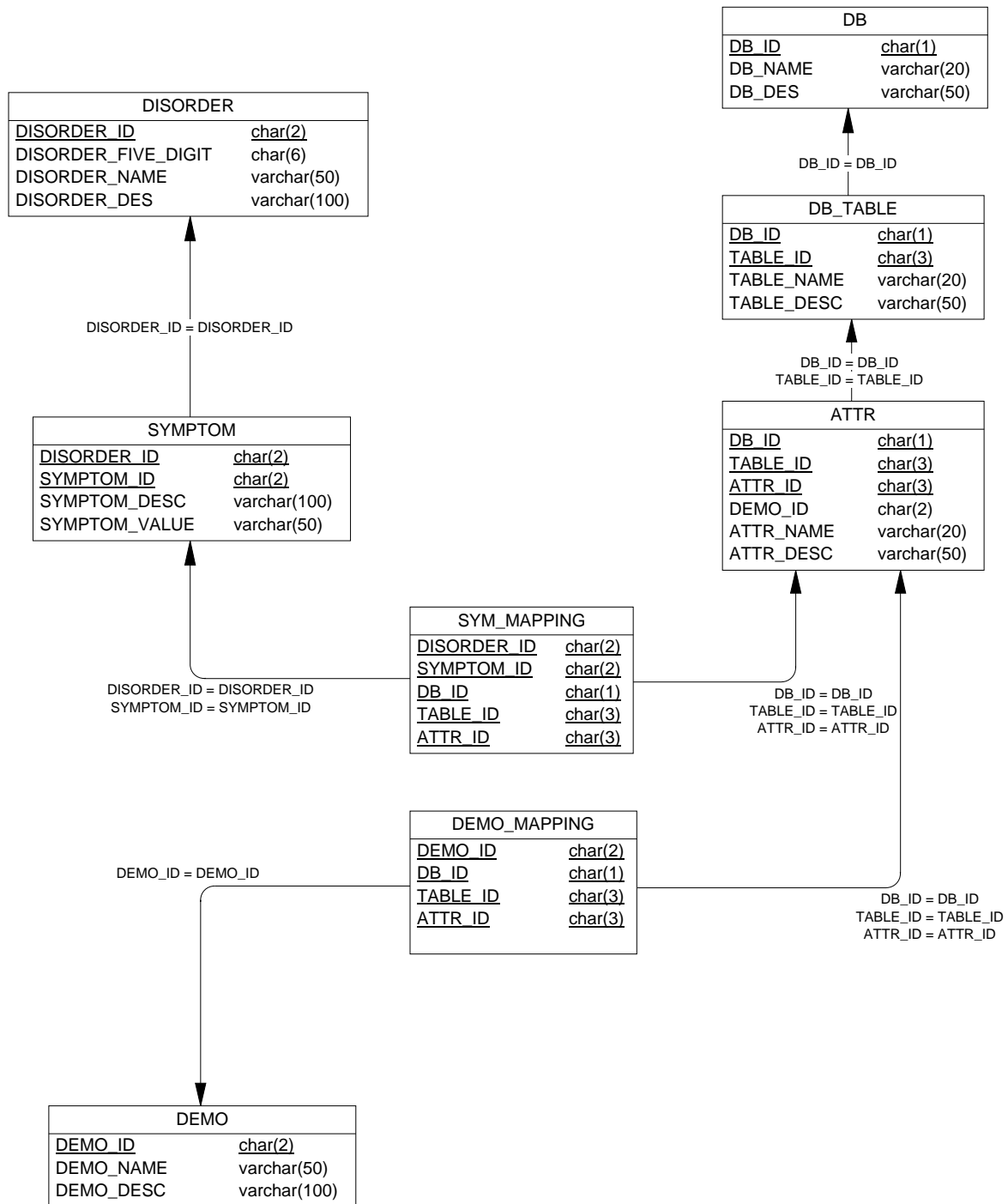


Figure 4.1 Global schema structures

TABLE	DESCRIPTION
DISORDER	IIIR and IV disorders that user can query
SYMPTOM	Symptoms and disorders relationship
DB	Caption of the two databases information
DB_TABLE	Tables and database relationship
TABLE_ATTR	Attributes and tables relationship
DEMO	Available demographic features of the patients in the database
SYM_MAPPING	Mapping from disorder symptoms to attributes
DEMO_MAPPING	Mapping from global demographic features to local demographic features

Table 4.1 Tables in global schema

3. Data of the tables in global schema

In this part, we list the complete contents of 3 tables from the global schema. Data of other tables can be obtained from the disorder definitions and mapping relationships in the appendixes and part III.

(1) DISORDER table

There are totally 15 kinds of Bipolar disorders in IIIR and IV. The information of these Bipolar disorders is stored in the table of DISORDER. The attribute **DISORDER_FIVE_DIGIT** stands for the code of the disorder used in the medical community. The attribute **DISORDER_TYPE** stands for the type of the disorder definition. E.g. DISORDER_TYPE=3 means this is a IIIR disorder.

From this table we can process the queries about the Bipolar disorder:

- Given the code of the disorder, query the number of the patient who have such kind of disorder;
- Given the code of the disorder and the type of the disorder, query the number of patient who have this kind of disorder of a particular definition;
- When a new version of definition of a disorder is introduced, for example, Bipolar II in V , we can easily add it into our database.

DISORDER_ID	DISORDER_FIVE_DIGIT	DISORDER_TYPE	DISORDER_NAME	DISORDER_DES
01	296.0x	4	Bipolar Single Manic	
02	296.40	4	Bipolar Most Recent Episode Hypomanic	
03	296.4x	3	Bipolar Manic	
04	296.5x	3	Bipolar Depressed	
05	296.6x	3	Bipolar Mixed	
06	296.70	3	Bipolar NOS	
07	296.4x	4	Bipolar Most Recent Episode Manic	
08	301.13	3	Cyclothymia	
09	296.6x	4	Bipolar, Most Recent Episode Mixed	
10	296.5x	4	Bipolar Most Recent	

			Episode Depressed	
11	296.5x	4	Bipolar Most Recent Episode Depressed	
12	296.7	4	Bipolar Most Recent Episode Unspecified	
13	296.89	4	Bipolar II	
14	301.13	4	Cyclothymic	
15	296.80	4	Bipolar NOS	

Table 4.2 Data in the DISORDER table

(2) DEMO table

This table contains demographic attributes of the patients. They can be mapped to actual attributes of the tables in the two databases. From this table, we can query the personal information, such as gender, birthday, age and etc.

DEMO_ID	DEMO_NAME	DEMO_DESC
01	SSN	Social Security Number
02	Gender	Male / Female
03	Birthday	Date of Birth
04	Age	Age
05	Race	American/Asian/African...

Table 4.3 Data in the DEMO table

(3) DEMO_MAPPING table

The table gives the mapping between the demographic attribute in global schema and the local attribute in two databases. E.g., **Gender** in global schema maps to **Gender** in DB1 and **SEX** in DB2.

DEMO_ID	DB_ID	TABLE_ID	ATTR_ID
01	01	Demo_1	Last4SSN
01	02	Baseline_Demo	SOC_SEC
02	01	Demo_1	Gender
02	02	Baseline_Demo	SEX
03	01	Demo_1	DOB
03	02	Baseline_Demo	BIR_DAT
04	01	Demo_1	DOB
04	02	Baseline_Demo	AGE
05	01	Demo_1	Race
05	02	Baseline_Demo	RACE

Table 4.4 Data in the DEMO_MAPPING table

V. Typical queries and an example

1. Typical queries

According to the information from the Psychiatric Institute, they mainly process three types of queries.

(1) Disorder information

This type of query cares about disorder information of specific patient. It includes:

- Disorder name identification: Given a patient, it tries to identify what kind of disorder the patient has. E.g., What kind of Bipolar disorder does John has? Does Tom have an IV Bipolar II disorder?
- Disorder symptoms discovery: Given a patient, it tries to find the severity of a specific symptom associated with the disorder the patient has. E.g., How bad is John on his “lack of sleep” symptom?
- Disorders conversion: Given the IIR disorder name that a patient has, it tries to convert it to corresponding IV Bipolar disorder.

(2) Patient personal information

This type of query cares about personal information of a specific patient. E.g., How old is patient John? What is the race of Marry?

(3) Statistic information

This type of query cares about statistic information among a group of patients. E.g., What is the percentage of the patients in DB 1, who have IIR Bipolar II disorder and are 25 years or older? How the patients are distributed in different time periods?

2. Sample query

In this part, we use a sample query process to illustrate the query process on the global schema.

(1) Global query construction

Global user constructs his/her query based on the global schema and submits the query.

To find:	Name, gender of all of the patients
Constrains:	25 years or older, IV Bipolar II disorder patient

(2) Disorder → symptoms decomposition

According to the table “DISORDER” and “SYMPTOM”, disorder is decomposed to related symptoms. i.e.,

IV definition = IIR definition + IV-criteria-E.

IIR definition = IIR-criteria-A + IIR-criteria-B + IIR-criteria-C +

(3) Symptoms and demographic caption → attributes mapping

- Using table SYM_MAPPING, map each symptom to corresponding attribute(s) in tables in the two databases.
- Using table DEMO_MAPPING, map each demographic feature into attributes in tables in the two databases. E.g., “gender” is defined as “Sex” in DB1, and as “gender” in DB2.

(4) Sub-query building

Build two queries, one of which is related with DB 1 and other of which is related with DB 2. For example, the query for DB 1 is like:

```
SELECT a.subject-name, a.subject-sex
FROM patient-demo a, sans b, bprs c
WHERE (a.subject-id=b.subject-id)
      AND (a.subject-id = c.subject-id)
      AND (b.attr1 > 5)
      AND (b.attr3 >6)
      AND (b.attr8 >4)
      AND (c.attr2 >5)
      AND ...
```

There is going to have MANY such constrains, which represent all of the symptoms.

(5) Sub-query execution

Submit the single-database queries to corresponding databases and get result set RS1 and RS2 from 2 databases. The two result sets will be returned to global schema layer.

(6) Result sets assembly

At the global schema level, combine 2 result sets by using union operation.

(7) Final result set returning

Return the final result set to the global user.

The above seven steps can be presented as the following figure:

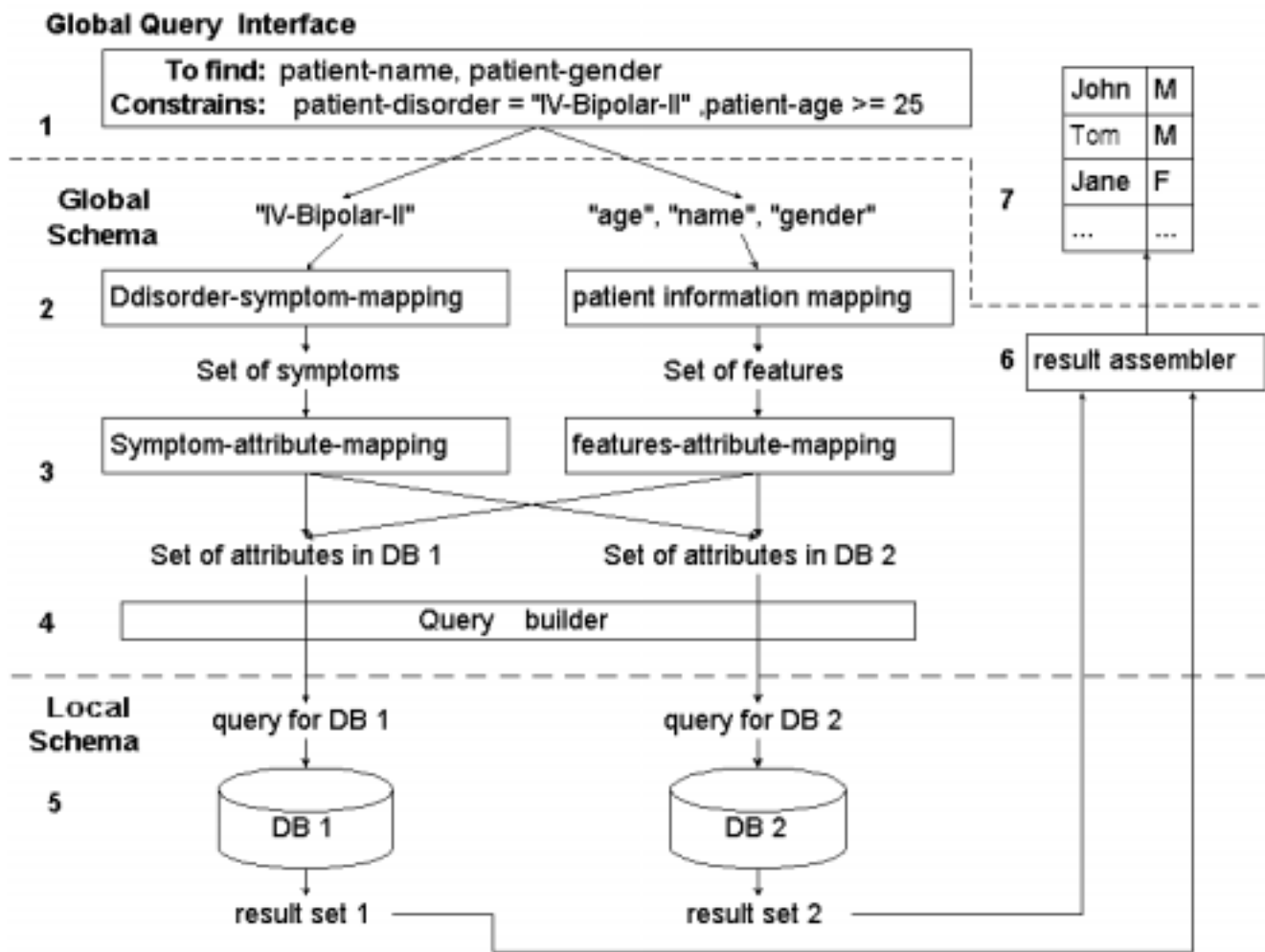


Figure 5.1 Major steps of querying process

VI. Conclusions

According to our design, this global schema can be applied to solve the typical global queries to the two psychiatric databases. Further efforts can be made to discover more applied queries.

Appendix 1 Reference

- [1] Diagnostic and Statistical Manual of Mental Disorders, Third Edition - Revised, American Psychiatric Association, 1987
- [2] Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, American Psychiatric Association, 1994
- [3] Principles of Database Query Processing for Advanced Applications, Clement Yu, Weiyi Meng, pages 117-158, 1997
- [4] Learning to Map between Ontologies on the Semantic Web, AnHai Doan, Jayant Madhavan, Pedro

Domingos , Alon Halevy, Proceedings of the eleventh international conference on World Wide Web, May 2002

[5] Learning Mappings between Data Schemas, A. Doan, P. Domingos, and A. Levy. Proceedings of the AAAI-2000 Workshop on Learning Statistical Models from Relational Data, 2000, Austin, TX.

[6] Reconciling Schemas of Disparate Data Sources: A Matching-Learning Approach, A. Doan, P. Domingos, and A. Levy, In SIGMOD, pages 509-520, 2001.

Appendix 2 Criteria of Episodes in Bipolar Disorders

Criteria of Episodes in IIR

III Manic Episode (for Hypomanic, other than point C)

A distinct period of abnormally and persistently elevated, expansive, or irritable mood

During the mood disturbance period, at least three of the following symptoms have persisted (four if the mood is only irritable) and have been present to a significant degree:

Inflated self-esteem or grandiosity

Decreased need for sleep

More talkative than usual or pressure to keep talking

Flight of ideas or subjective experience that thoughts are racing

Distractibility, i.e., attention too easily drawn to unimportant or irrelevant external stimuli

Increase in goal-directed activity or psychomotor agitation

Excessive involvement in pleasurable activities which have a high potential for painful consequences, e.g., the person engages in unrestrained buying sprees, sexual indiscretions, or foolish business investments

Mood disturbance sufficiently severe to cause marked impairment in occupational functioning or in usual social activities or relationships with others, or to necessitate hospitalization to prevent harm to self or others

At no time during the disturbance have there been delusions or hallucinations for as long as two weeks in the absence of prominent mood symptoms

Not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS

It cannot be established that an organic factor initiated and maintained the disturbance

III Major Depressive Episode

At least 5 of the following symptoms have been present during the same 2-week period and represent a change from previous functioning at least one of the symptoms is either (1) depressed mood or (2) loss of interest or pleasure

Depressed mood most of the day, nearly every day. In children and adolescents, can be irritable mood.

Markedly diminished interest or pleasure in all, or almost all, activities most of the day, nearly every day

Significant weight loss when not dieting or weight gain, or decrease or increase in appetite nearly every day. In children, consider failure to make expected weight gains

Insomnia or hypersomnia nearly every day

Psychomotor agitation or retardation nearly every day

Fatigue or loss of energy nearly every day

Feelings of worthlessness or excessive or inappropriate (delusional) guilt nearly every day

Diminished ability to think or concentrate, or indecisiveness, nearly every day

Recurrent thoughts of death, recurrent suicidal ideation without a specific plan, or a suicide attempt or a specific plan for committing suicide

It cannot be established that an organic factor initiated and maintained the disturbance
The disturbance is not a normal reaction to the death of a loved one
At no time during the disturbance have there been delusions or hallucinations for as long as two weeks in the absence of prominent mood symptoms
Not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS

Criteria of Episodes in IV

IV Manic Episode

A distinct period of abnormally and persistently elevated, expansive, or irritable mood, lasting at least 1 week

During the mood disturbance period, at least three of the following symptoms have persisted (four if the mood is only irritable) and have been present to a significant degree:

Inflated self-esteem or grandiosity

Decreased need for sleep

More talkative than usual or pressure to keep talking

Flight of ideas or subjective experience that thoughts are racing

Distractibility, i.e., attention too easily drawn to unimportant or irrelevant external stimuli

Increase in goal-directed activity or psychomotor agitation

Excessive involvement in pleasurable activities which have a high potential for painful consequences, e.g., the person engages in unrestrained buying sprees, sexual indiscretions, or foolish business investments

The symptoms do not meet criteria for a Mixed Episode (No Major Depressive Episode)

The mood disturbance is sufficiently severe to cause marked impairment in occupational functioning or in usual social activities or relationships with others, or to necessitate hospitalization to prevent harm to self or others

The symptoms are not due to the direct physiological effects of a substance or a general medical condition

IV Hypomanic Episode

A distinct period of abnormally and persistently elevated, expansive, or irritable mood, lasting at least 4 days

During the mood disturbance period, at least three of the following symptoms have persisted (four if the mood is only irritable) and have been present to a significant degree:

Inflated self-esteem or grandiosity

Decreased need for sleep

More talkative than usual or pressure to keep talking

Flight of ideas or subjective experience that thoughts are racing

Distractibility, i.e., attention too easily drawn to unimportant or irrelevant external stimuli

Increase in goal-directed activity or psychomotor agitation

Excessive involvement in pleasurable activities which have a high potential for painful consequences, e.g., the person engages in unrestrained buying sprees, sexual indiscretions, or foolish business investments

The episode is associated with an unequivocal change in functioning that is uncharacteristic of the person when not symptomatic

The disturbance in mood and the change in functioning are observable by others

The episode is not severe enough to cause marked impairment or occupational functioning, or to necessitate hospitalization, and there are no psychotic features

The symptoms are not due to the direct physiological effects of a substance or a general medical condition

IV Major Depressive Episode

5 or more of the following symptoms have been present during the same 2-week period and represent a change from previous functioning at least one of the symptoms is either (1) depressed mood or (2) loss of interest or pleasure

Depressed mood most of the day, nearly every day. In children and adolescents, can be irritable mood.

Markedly diminished interest or pleasure in all, or almost all, activities most of the day, nearly every day

Significant weight loss when not dieting or weight gain, or decrease or increase in appetite nearly every day. In children, consider failure to make expected weight gains

Insomnia or hypersomnia nearly every day

Psychomotor agitation or retardation nearly every day

Fatigue or loss of energy nearly every day

Feelings of worthlessness or excessive or inappropriate (delusional) guilt nearly every day

Diminished ability to think or concentrate, or indecisiveness, nearly every day

Recurrent thoughts of death, recurrent suicidal ideation without a specific plan, or a suicide attempt or a specific plan for committing suicide

The symptoms do not meet criteria for a Mixed Episode (no Manic Episode)

The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning

The symptoms are not due to the direct physiological effects of a substance or a general medical condition

The symptoms are not better accounted for by Bereavement

IV Mixed Episode

The criteria are met both for a Manic Episode and for a Major Depressive Episode nearly every day during at least a 1-week period

The mood disturbance is sufficiently severe to cause marked impairment in occupational functioning or in usual social activities or relationships with others, or to necessitate hospitalization to prevent harm to self or others

The symptoms are not due to the direct physiological effects of a substance or a general medical condition

Appendix 3 Criteria of Bipolar Disorders

Criteria of Bipolar Disorders in IIR

296.6x Bipolar Disorder, Mixed

Current (or most recent) episode involves the full symptomatic picture of both Manic and Major Depressive Episodes, intermixed or rapidly alternating every few days

Prominent depressive symptoms lasting at least a full day

296.4x Bipolar Disorder, Manic

Currently (or most recent) in a Manic Episode

296.5x Bipolar Disorder, Depressed

Has had one or more Manic Episodes

Currently (or most recent) in a Major Depressive Episode

Bipolar II

At least one Hypomanic Episode and at least one Major Depressive Episode, but never either a Manic

Episode or Cyclothymia.
<p>301.13 Cyclothymia</p> <p>For at least 2 years (1 year for children and adolescents), presence of numerous Hypomanic Episodes and numerous periods with depressed mood or loss of interest or pleasure that did not meet criterion A of Major Depressive Episode</p> <p>During a 2-year period (1 year for children and adolescents) of the disturbance, never without hypomanic or depressive symptoms for more than two months at a time</p> <p>No clear evidence of a Major Depressive Episode or Manic Episode during the first 2 years of the disturbance (1 year for children and adolescents)</p> <p>Not superimposed on a chronic psychotic disorder</p> <p>It cannot be established that an organic factor initiated and maintained the disturbance</p>
<p>296.70 Bipolar Disorder Not Otherwise Specified</p> <p>Disorders with manic or hypomanic features that do not meet the criteria for any specific Bipolar Disorder</p> <p>One or more Hypomanic Episodes, but without Cyclothymia or a history of either a Manic or a Major Depressive Episode</p> <p>A Manic Episode superimposed on Delusional Disorder, residual Schizophrenia, or Psychotic Disorder NOS</p>

Criteria of Bipolar Disorders in IV

<p>296.0x Bipolar I Disorder, Single Manic Episode</p> <p>Presence of only one Manic Episode and no past Major Depressive Episodes</p> <p>The Manic Episode is not better accounted for by Schizoaffective Disorder and are not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS</p> <p>296.40 Bipolar I Disorder, Most Recent Episode Hypomanic</p> <p>Current (or most recently) in a Hypomanic Episode</p> <p>There has previously been at least one Manic Episode or Mixed Episode</p> <p>The mood symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning</p> <p>The mood episodes in A and B are not better accounted for by Schizoaffective Disorder and are not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS</p> <p>296.4x Bipolar I Disorder, Most Recent Episode Manic</p> <p>A. Current (or most recently) in a Manic Episode</p> <p>There has previously been at least one Major Depressive, Manic Episode, or Mixed Episode</p> <p>The mood episodes in A and B are not better accounted for by Schizoaffective Disorder and are not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS</p> <p>296.6x Bipolar I Disorder, Most Recent Episode Mixed</p> <p>A. Current (or most recently) in a Mixed Episode</p> <p>There has previously been at least one Major Depressive, Manic Episode, or Mixed Episode</p> <p>The mood episodes in A and B are not better accounted for by Schizoaffective Disorder and are not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS</p> <p>296.5x Bipolar I Disorder, Most Recent Episode Depressed</p>
--

A. Current (or most recently) in a Major Depressive Episode
There has previously been at least one Manic Episode, or Mixed Episode
The mood episodes in A and B are not better accounted for by Schizoaffective Disorder and are not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS

296.7 Bipolar I Disorder, Most Recent Episode Unspecified

Criteria, except for duration, are currently (or most recently) met for a Manic, a Hypomanic, a Mixed, or a Major Depressive Episode
There has previously been at least one Manic Episode, or Mixed Episode
The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning
The mood episodes in A and B are not better accounted for by Schizoaffective Disorder and are not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS
The symptoms in A and B are not due to the direct physiological effects of a substance or a general medical condition

296.89 Bipolar II disorder

Presence (or history) of one or more Major Depressive Episodes
Presence (or history) of at least one Hypomanic Episode
There has never been a Manic Episode or a Mixed Episode
The mood symptoms in A and B are not accounted for by Schizoaffective Disorder and are not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS
The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning

301.13 Cyclothymic Disorder

A. For at least 2 years (1 year for children and adolescents), the presence of numerous periods with hypomanic symptoms and numerous periods with depressive symptoms that do not meet criteria for a Major Depressive Episode
During the above 2-year period (1 year for children and adolescents), the person has not been without the symptoms in A for more than 2 months at a time
No Major Depressive Episode, Manic Episode, or Mixed Episode has been present during the first 2 years of the disturbance
The symptoms in A are not accounted for by Schizoaffective Disorder and are not superimposed on Schizophrenia, Schizophreniform Disorder, Delusional Disorder, or Psychotic Disorder NOS
The symptoms are not due to the direct physiological effects of a substance or a general medical condition
The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning

296.80 Bipolar Disorder Not Otherwise Specified

Disorders with bipolar features that do not meet criteria for any specific Bipolar Disorder
Very rapid alternation (over days) between manic symptoms and depressive symptoms that do not meet minimal duration criteria for a Manic episode or a Major Depressive Episode
2. Recurrent Hypomanic Episodes without intercurrent depressive symptoms
A Manic or Mixed Episode superimposed on Delusional Disorder, residual Schizophrenia, or Psychotic Disorder NOS
Situations in which the clinician has concluded that a Bipolar Disorder is present but is unable to determine whether it is primary, due to a general medical condition, or substance induced

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