

Billing Rules Functional Design

1. Rules Design Objectives

Guidelines used to aid the design process.

2. Requirement Analysis

An in-depth consideration of the requirement using the design guidelines as boundary conditions.

3. Design Theory – Rules Modeling

Distill the lessons learned from analyzing the requirement into a model.

4. Architectural Implementation

Equating the rules model to an Idiom solution.

5. A Repeatable Process

A sustainable approach to maintenance and the creation of new rules.

Billing Rules Design Objectives

1. Rules should be adaptable

Rules should be configurable so that it will be possible to change the parameters of a decision without having to change the underlying rule logic.

2. Flexibility should not be a hindrance

Rule configurations and structure should not be monolithic and should be maintainable by an easy to use application/interface.

3. Rules should approximate human thinking

The rules structure should be a self defining workflow of simplified steps which would best approximate an intuitive decisioning pattern to aid troubleshooting and maintenance by subject matter experts.

4. Units of work should follow a repeatable pattern

Rule sets should conform to a common architecture which forms a rules framework or a method of resolving requirements.

Requirement Analysis

- The ChargeTable spreadsheet defines the billing rules by category e.g. 1.1 Inpatient – Deposit, 1.2 Inpatient - Admission fee, 1.3 IP - Maint fee(Patient).

Microsoft Excel screenshot showing the PBRC_HAChargeTable.xls spreadsheet. The spreadsheet defines billing rules by category. The visible data is as follows:

Rule #	Patient Group	Public/Private	Hospital	Ward Class	Day Case	Operation Required (Y/N)	Magnitude of Operatic	Paid with the Obstetric Package Char	Patient Charges	Charge Unit	Reference	Notes	Valid Indicator (Y/N)
1	EP	Public		3rd					0	per case	ACN-8/2004 Annex		Y
2	EP / NEP / HA(B3)	Public	RH	SAW					9,600	per case	ACN-8/2004 Annex		Y
3	EP / NEP / HA(B3)	Public	GH	SAW					10,800	per case	ACN-8/2004 Annex		Y
4	EP / NEP / HA(B3)	Public	PYNEH	SAW					14,400	per case	ACN-8/2004 Annex		Y
5	NEP	Public	Acute / Non-Acute	3rd					33,000	per case	ACN-8/2004 Annex		Y
6	NEP	Public	Acute	3rd				Y	33,000	per case	Working Guidelines on the implementation of NEP Obstetric Package Charge; para. 11.3	7	Y
7	NEP	Public	Psychiatric	3rd					7,200	per case	ACN-8/2004 Annex	1	Y
8		Private	Acute (excl. AHN)	1st	No	N			60,000	per case	ACN-8/2004 Annex	2	Y
9		Private	Acute (excl. AHN)	1st	No	Y	Minor		60,000	per case	ACN-8/2004 Annex	2	Y
10		Private	Acute (excl. AHN)	1st	No	Y	Intermediate		60,000	per case	ACN-8/2004 Annex	2	Y
11		Private	Acute (excl. AHN)	1st	No	Y	Major		100,000	per case	ACN-8/2004 Annex	2	Y
12		Private	Acute (excl. AHN)	1st	No	Y	Ultramajor		100,000	per case	ACN-8/2004 Annex	2	Y

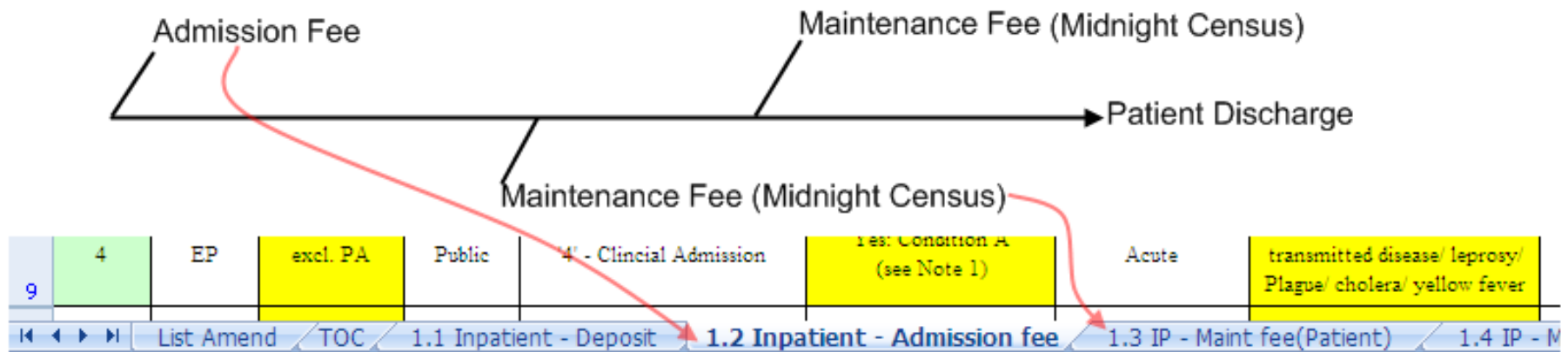
The spreadsheet also includes a 'Source System' section with the following details:

- Source System: PBRC DEPOSIT_RATES
- Table/Procedure: Annex 1
- Data Item/Field: Hospital_code, Ward Class (adm_war d_class), deposit_rate
- By coding (Y/N): N

Requirement Analysis

- Each category (tab on spreadsheet) is analogous to a unit of billing work that must be undertaken for an event which occurs within the timeline of a patient encounter

Simple Patient Occurrence Timeline



- Conclusion – a rule set should be created for every category of billing rules.

Requirement Analysis

- Each unit of billing work e.g. 1.2 Inpatient - Admission fee is broken down further into a set of billing rules which may or may not apply to a patient encounter

Rule #	Patient Group	Public / Private	Hospital	Ward Class	Day Case	Operation Required (Y/N)	Magnitude of Operatic	Paid with the Obstetric Package Char.	Patient Charges	Charge Unit	Reference	Notes	Valid Indicator (Y/N)
1	EP	Public		3rd					0	per case	ACN-8/2004 Annex		Y
2	EP / NEP / HA(B3)	Public	RH	SAW					9,600	per case	ACN-8/2004 Annex		Y
3	EP / NEP / HA(B3)	Public	GH	SAW					10,800	per case	ACN-8/2004 Annex		Y
4	EP / NEP / HA(B3)	Public	PYNH	SAW					14,400	per case	ACN-8/2004 Annex		Y
5	NEP	Public	Acute / Non-Acute	3rd					33,000	per case	ACN-8/2004 Annex		Y
6	NEP	Public	Acute	3rd				Y	33,000	per case	Working Guidelines on the implementation of NEP Obstetric Package Charge; para. 11.3	7	Y
7	NEP	Public	Psychiatric	3rd					7,200	per case	ACN-8/2004 Annex	1	Y
8		Private	Acute (encl. AHN)	1st	No	N			60,000	per case	ACN-8/2004 Annex	2	Y

Each row is a billing rule which conditionally raises a charge for a patient occurrence.

Requirement Analysis

- Each billing rule defines a set of conditions under which the billing rule may raise a charge against the patient encounter

Rule #	Patient Group	Patient Type	Public / Private	Admission Source [a] <Note 11>	(Cases under admission source = 4) Under specific conditions?	Type of Wards [b] <Note 11>	Disease	Ward Class
2	EP	excl. PA	Public	'3' - A&E		Acute	<u>NOT</u> Tuberculosis/ sexually transmitted disease/ leprosy/ Plague/ cholera/ yellow fever	

- Each column defines a condition for which the billing charge may be raised e.g. in order for this billing charge to be raised the patient must belong to patient group EP AND NOT be of patient type PA AND the admission source must be A&E AND the type of ward must be a Acute and the Disease must not be one of the following Tuberculosis, Sexually Transmitted Disease.....
- So all conditions must be true for a billing rule in order to raise a charge against the patient encounter

Requirement Analysis

- Lets take a closer look at the conditions themselves

Rule #	Patient Group	Patient Type	Public / Private	Admission Source [a] <Note 11>	(Cases under admission source = 4) Under specific conditions?	Type of Wards [b] <Note 11>	Disease	Ward Class
2	EP	excl. PA	Public	'3' - A&E		Acute	<u>NOT</u> Tuberculosis/ sexually transmitted disease/ leprosy/ Plague/ cholera/ yellow fever	
	a EP	b excl. PA					c <u>NOT</u> Tuberculosis/ sexually transmitted disease/ leprosy/ Plague/ cholera/ yellow fever	

- A condition may imply an equals condition to state that a patient value must equate to a specific value e.g. in this case Patient Group must be EP.
 - A condition may also imply a not equals condition to state that a Patient type may not be of a certain value e.g. in this case Patient Type must not be PA.
 - A condition may also imply the exclusion/Inclusion of a set of patient values
- Conclusion – conditions for raising a billing charge will have to cater for both traditional Equals/ Not equals evaluations and Enumeration evaluations where we have to check if a value falls into an acceptable/unacceptable set.

Requirement Analysis

- Lets go back and have a look at an example billing charge

5	Rule #	Patient Group	Patient Type	Public / Private	Admission Source [a] <Note 11>	(Cases under admission source = 4) Under specific conditions?	Type of Wards [b] <Note 11>	Disease	Ward Class	Overflow Bed?	Admitted Specialty	Patient Charges (\$)	Charge Unit
7	2	EP	excl. PA	Public	'3' - A&E		Acute	<u>NOT</u> Tuberculosis/ sexually transmitted disease/ leprosy/ Plague/ cholera/ yellow fever		No	excl. REH / INF / PSY / MHU / HOME	0	per attendance

- A billing rule will have at least 1 condition under which we raise a charge e.g.
 - If <Patient Group> AND <Patient Type> AND <IsPublic> AND <Disease>
- All rules for a unit of work have the same type of conditions (with a few exceptions).
- Any business rule that has a large number of conditions is typically difficult to maintain. In addition sustainability suffers as more conditions are added.
- Conclusion – Each condition could be expressed as a rule within a workflow which would imply the AND relationship between each step. This would allow us to break up rules into smaller steps of individual evaluations.

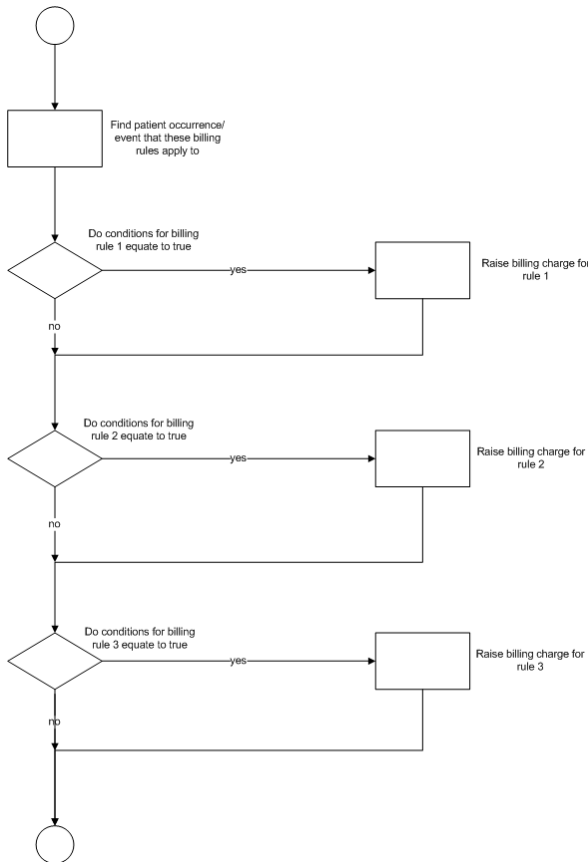
Requirement Analysis

Summary

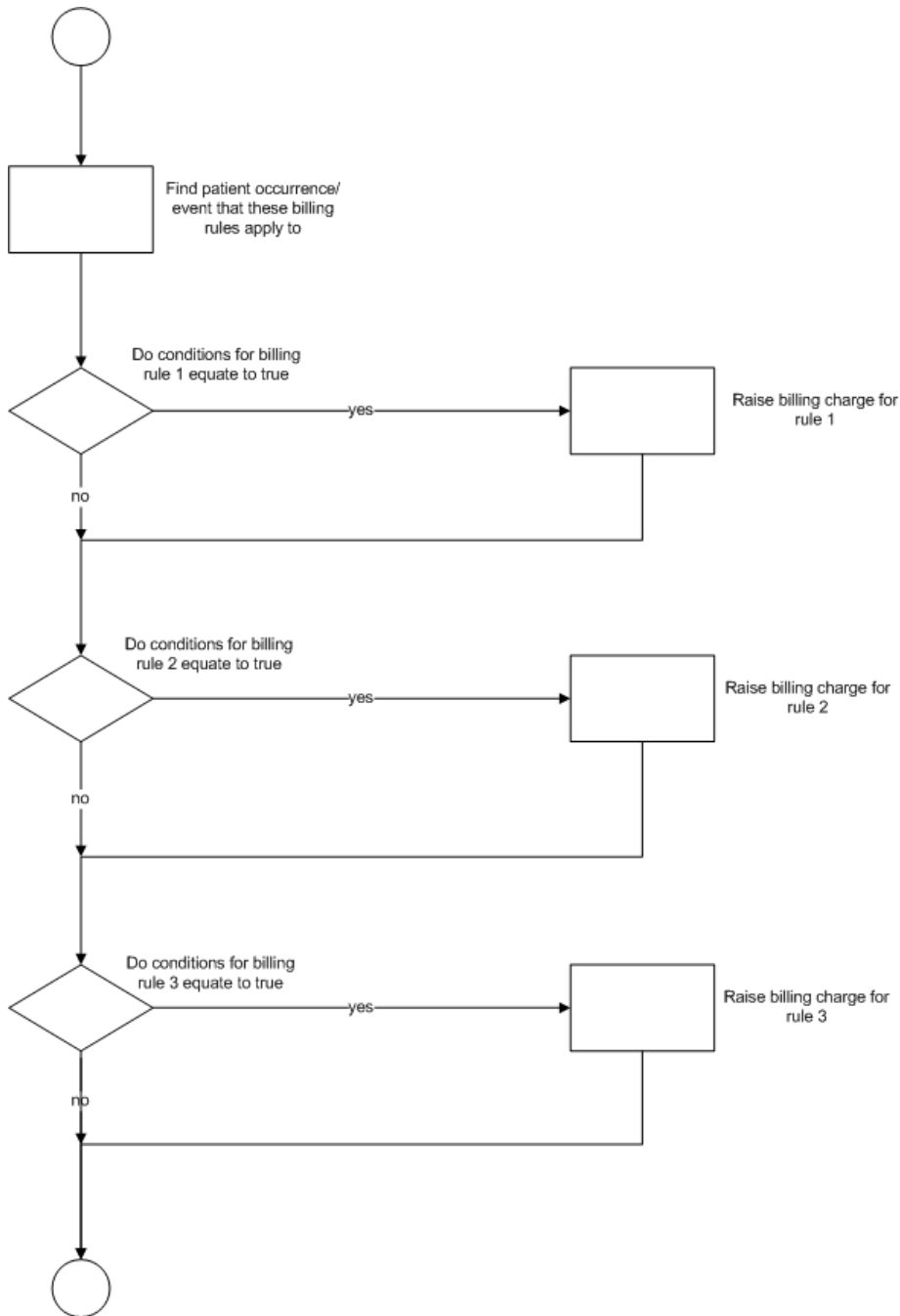
1. A rule set should be created for every category of billing rules.
2. Conditions for raising a billing charge will have to cater for both traditional Equals/ Not equals evaluations and Enumeration evaluations where we have to check if a value falls into an acceptable/unacceptable set.
3. Each condition could be expressed as a rule within a workflow which would imply the AND relationship between each step. This would allow us to break up rules into smaller steps of individual evaluations.

Design Theory – Rules Modeling

- A rule set should be created for every category of billing rules.
- A category consists of a number of billing rules which must be evaluated for a patient occurrence/event.
- So a starting flowchart model for a rules category would look something like this :-



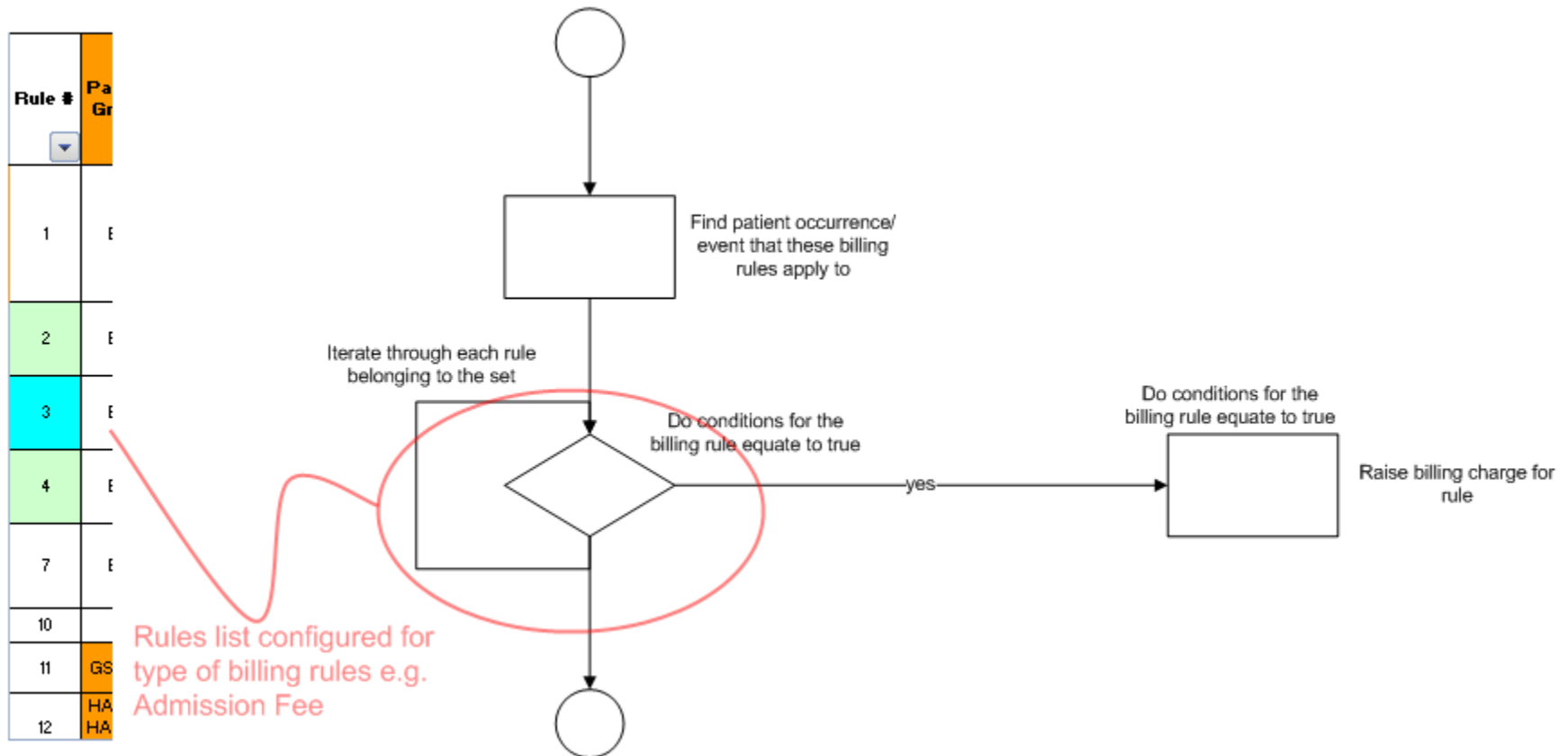
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1. For each applicable patient event
 2. The conditions for each rule are evaluated
 3. If a rule's conditions evaluate to true then a billing charge is raised
- This model assumes a simplistic design but is hardly elegant when you consider that a rule set for instance Maintenance Fee may have upwards of 70 billing rules to evaluate.
 - This model also shows that we are repeating the same process model for each rule. So we could improve on the model by iterating over a set of rules that belong to the rule set and performing the condition evaluation process to consider raising a billing charge.

Design Theory – Rules Modeling

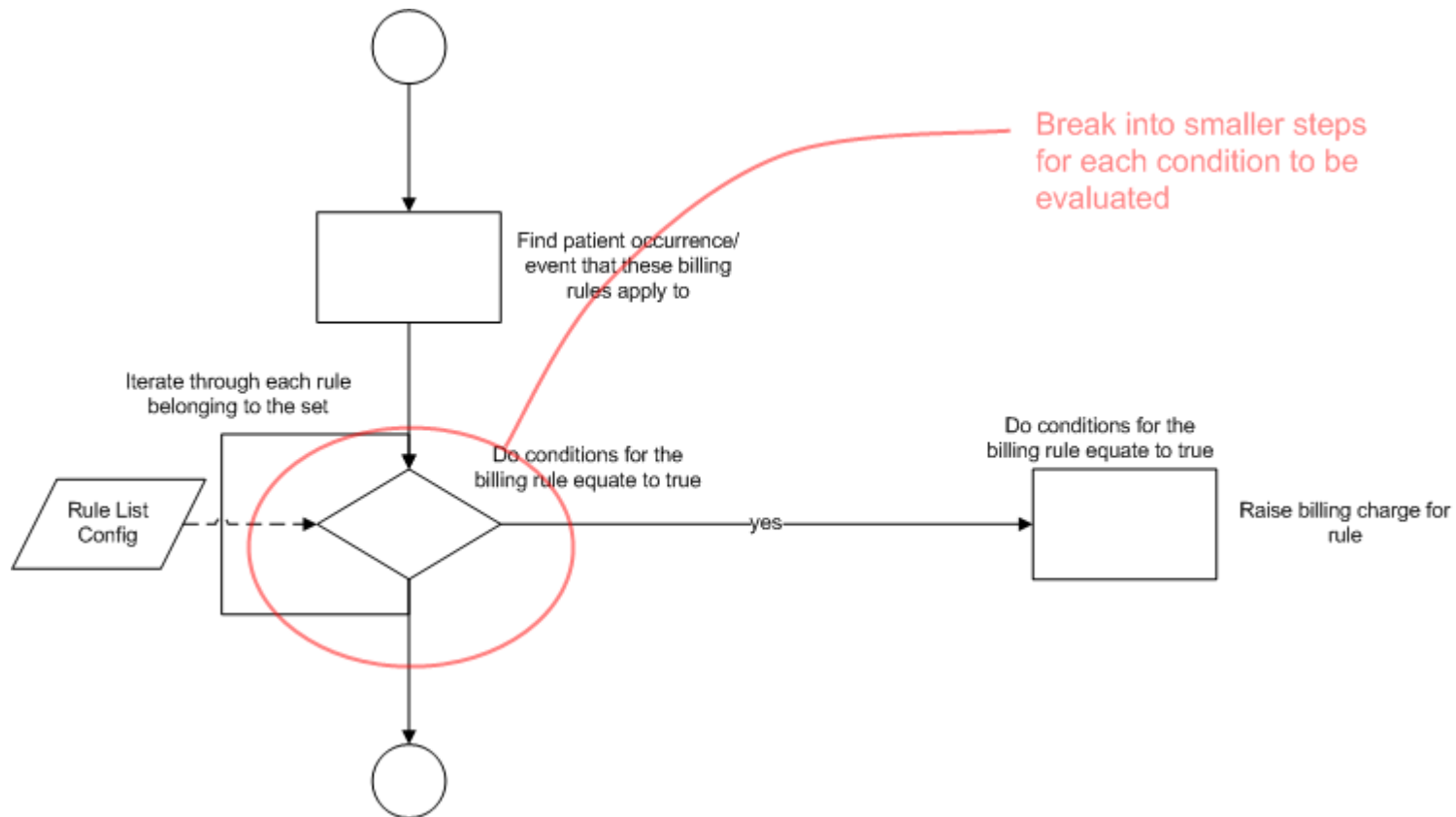
- So if we improve upon the previous model we would be inclined to loop through the applicable rules and then conditionally raise a billing charge like so :-



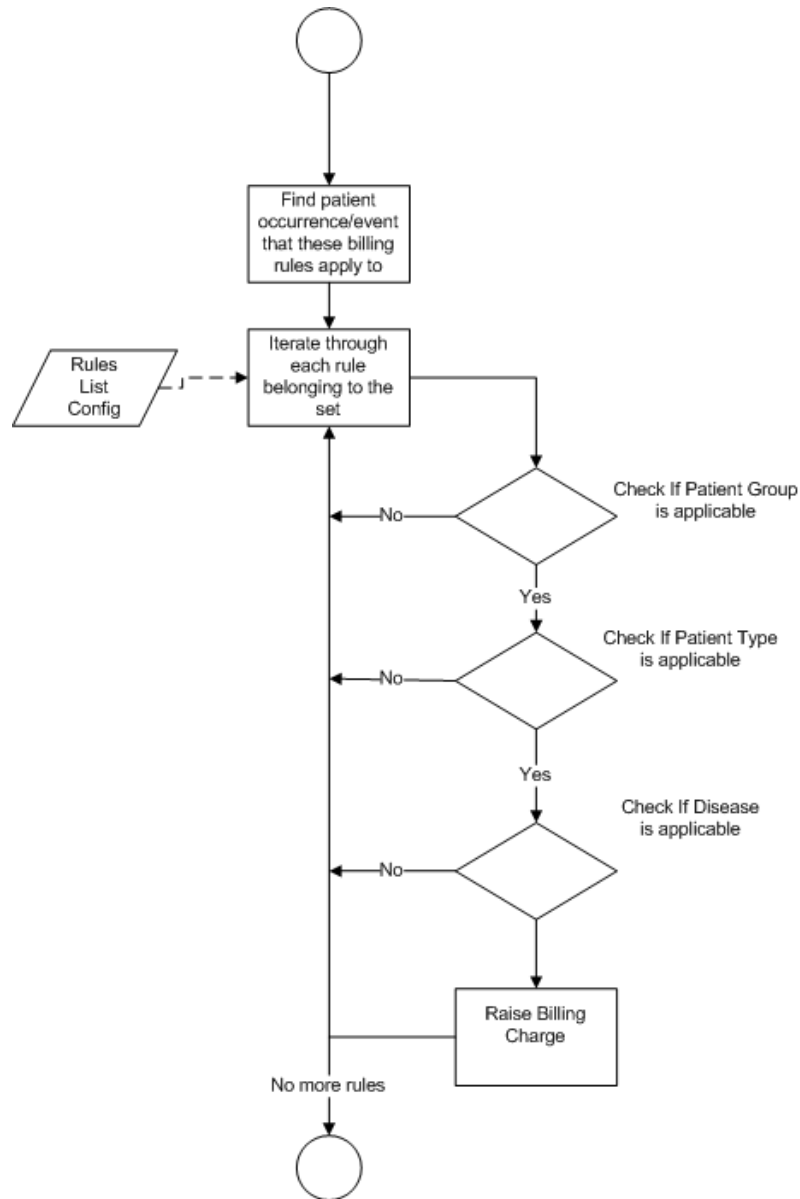
- The list of rules that we iterate through will be part of the configuration for the billing rule type.

Design Theory – Rules Modeling

- So now that we have improved on the basic design we need to concentrate on the conditional evaluation for each rule which we concluded we could improve upon by breaking the condition evaluation into smaller units of work. One for each conditional evaluation.



Design Theory – Rules Modeling



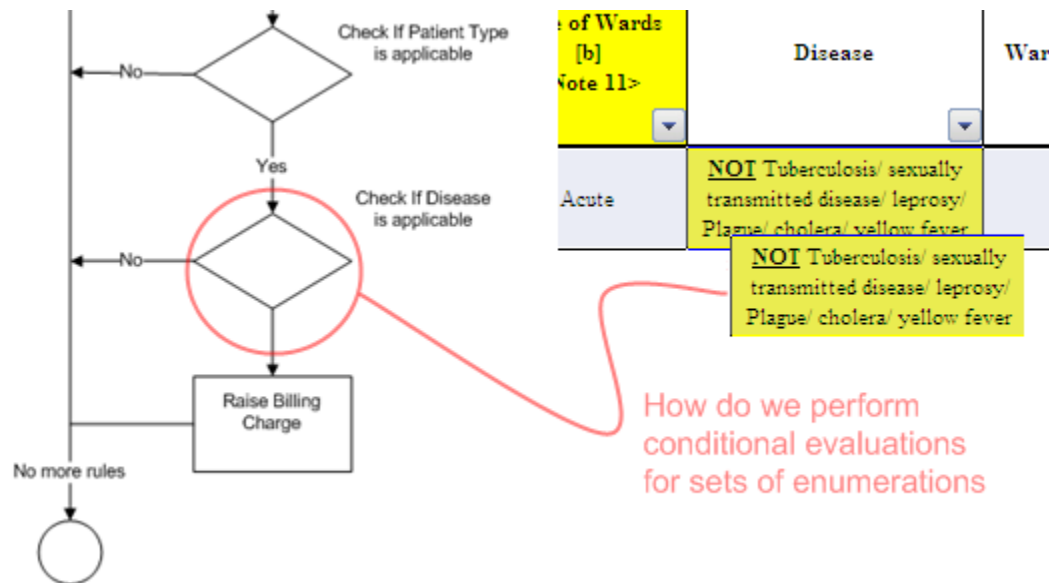
By breaking down the billing rule conditional evaluations into individual rules we have now created a structure whereby we can easily add and remove conditions.

In addition to gaining enhanced maintainability the design also represents a low risk for adding further conditions (more columns to a rules spreadsheet) as each conditional evaluation is sandboxed inside its own rule.

New rules can be added by adding new configurations for the billing rule category.

Design Theory – Rules Modeling

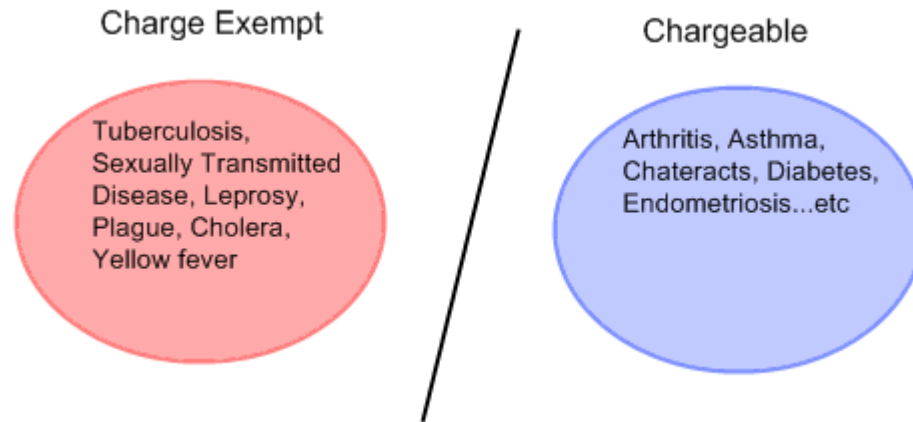
- The next issue to model is how we can perform conditional evaluations against enumerations in a CONFIGURABLE manner.
- We definitely don't want to be writing n number of rules that repeat the same Conditional logic for slightly different data sets.



- Looking at the disease conditions for applying this billing charge what the requirement is imparting is that we should not be raising a billing charge for patient occurrences where the disease is Tuberculosis, STD, leprosy....etc.
- By this we should be raising this billing charge for all other diseases.

Design Theory – Rules Modeling

- So there are a set of diseases that fall within the conditions of raising the charge and a set for which we don't want to raise the charge.

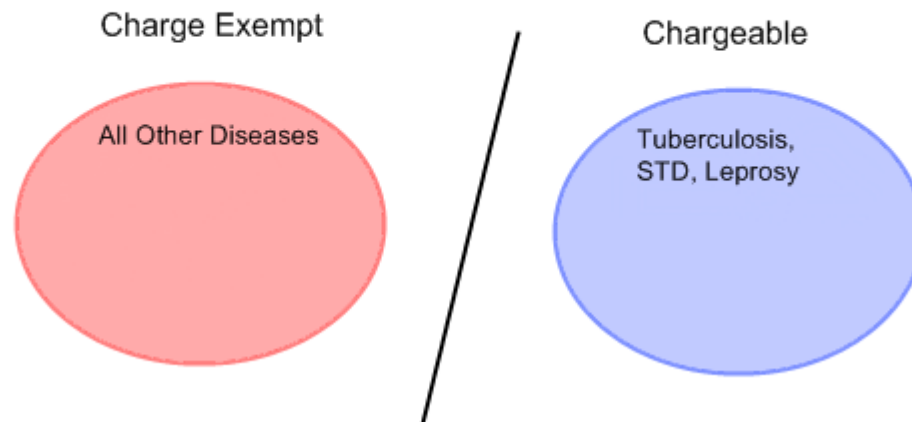


- But we don't want to create a rule that will test the patients disease against all the exemptions and then all the chargeable diseases. Because the list of chargeable diseases includes all diseases.
- So a better way to create a rule of this kind would be to simplify the condition such that we test against all the excluded diseases and if the patients disease is NOT one of these then we continue to raise the charge.

Design Theory – Rules Modeling

- So we would need to write a rule that tests against an exempt set of diseases.
- But this set of diseases is not the same for every rule, other rules imply that a charge should only be raised for Tuberculosis, STD, leprosy.

13	EP	Public			3rd	excl. HOME						Tuberculosis/ sexually transmitted disease/ leprosy
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- So this implies that the disease rule can't just raise charges based on an exempt set of diseases but in some cases has to raise charges based on the set of chargeable diseases.

Design Theory – Rules Modeling

- So creating a configurable rule is going to require the definition of a simple configuration meta language e.g.

Rule#	Disease	Included or Excluded for chargeable set
2	Tuberculosis	Excluded/Exempt
2	STD	Excluded/Exempt
2	Leprosy	Excluded/Exempt
2	Plague	Excluded/Exempt
2	All Others	Included/Chargeable

Rule#	Disease	Included or Excluded for chargeable set
10	Tuberculosis	Included/Chargeable
10	Leprosy	Included/Chargeable
10	STD	Included/Chargeable
10	All Others	Included/Chargeable

Design Theory – Rules Modeling

- So how will the rule know whether to check for exempt diseases or chargeable diseases ? The answer is it won't because for each rule in a set we may have to do one or both operations so the rule logic will have to follow a pattern of determination in order to reach a correct outcome.

Rule#	Disease	Included or Excluded for chargeable set
2	Tuberculosis	Excluded/Exempt
2	STD	Excluded/Exempt
2	Leprosy	Excluded/Exempt
2	Plague	Excluded/Exempt
2	All Others	Included

- So the rule will have to check if a disease has been explicitly included or excluded in the configuration. If the disease is not explicitly configured then the rule will have to check if there is a directive for all NON EXPLICITLY configured diseases to check if all others are CHARGEABLE or EXEMPT.

Design Theory – Rules Modeling

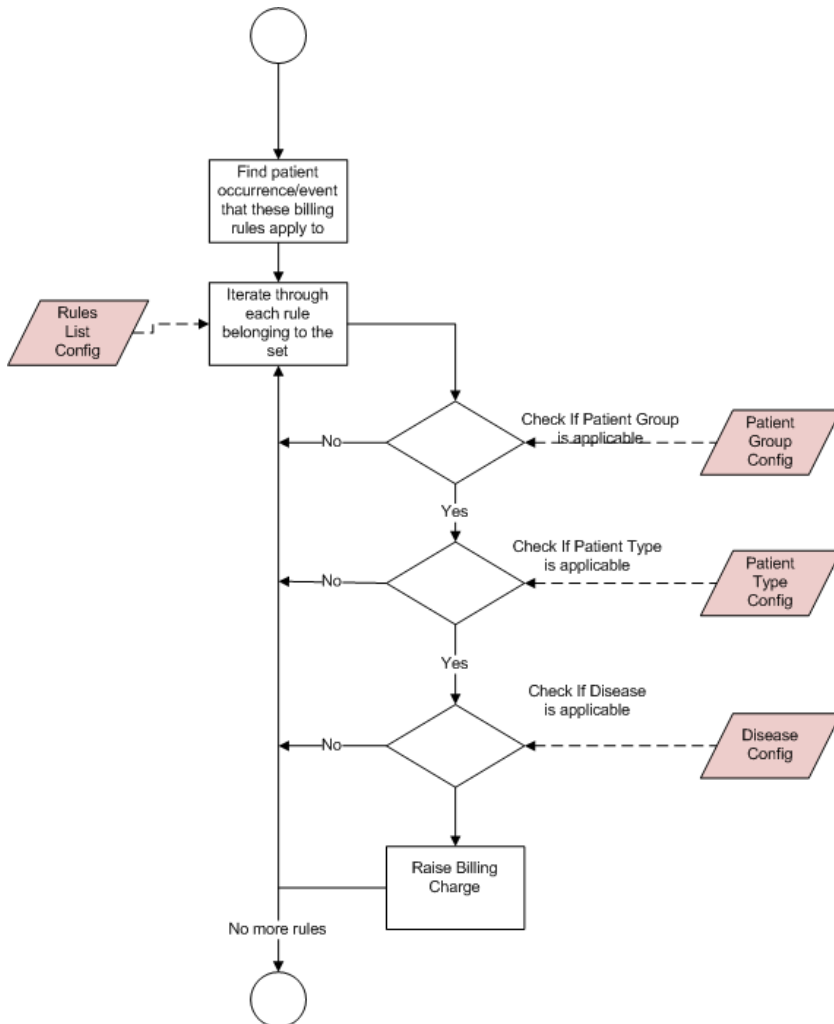
- Many of the billing rule conditions imply the same conditional logic throughout the requirement as shown by these Maintenance Fee Rules:-

Rule #	Patient Group	Public / Private	Hospital	Type of Wards [a] <Note 15>	Ward Class	Specialty [b] <Note 15>	Type of Diet	Obstetric Package (Y/N)	Hospitalization on Period covered by Package (Y/N)	Patient Age (at service date)	Disease	Overflow Bed?	CSR 924 or CSR 925 indicator [c] <Note 16>	Patient Charges (\$)	Charge Unit
1	EP	Public	excl. CHC / CHS	Acute	3rd	excl. REH / INF / PSY / MHU / HOME				>=12	NOT Tuberculosis/ sexually transmitted disease/ leprosy/ Plague/ cholera/ yellow fever			100	per day
23	EP / NEP / PRI	Private	Acute		1st	excl. HOME						No		3,900	per day
39	GS / WV			Non-Nursery	3rd	excl. HOME	European			>=12			No	147	per day

- So this configurable approach can be used where SET type evaluations are required.

Design Theory – Rules Modeling

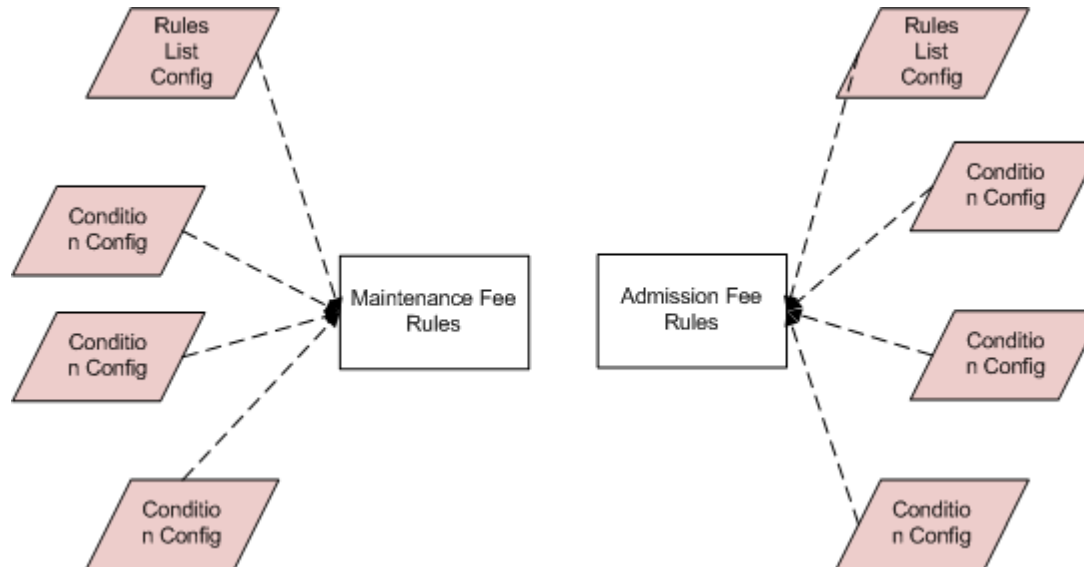
- So if we have a look at our model of a typical billing rule set it will look a little like this :-



- Each billing rules set will have a configuration for the list of rules that are applicable to that set.
- Individual configurations will be present for rule condition evaluations.
- Splitting the individual configurations up allows the configurations to be kept to a manageable size.
- Each condition's configurations are sandboxed into a single entity which allows a smaller targeted unit of work to be undertaken to change a configuration.

Design Theory – Rules Modeling

- So each rules set will have its own set of configuration assets e.g.



- Configurations will reside in tables.
- Each table will be editable
- Adding a new rule to a billing rules set will involve adding the required configurations and adding the rule id/number to the list of rules that are run for the billing rule set.

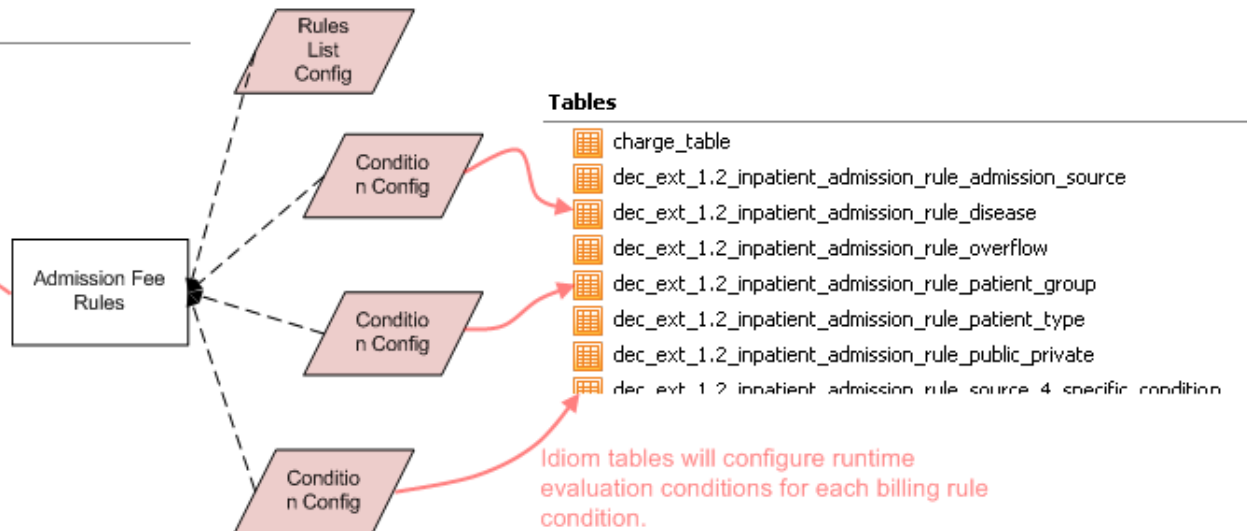
Rules Implementation

- To understand how the rules architecture is implemented its important to equate the items on the model to concepts in Idiom.
- So we can equate billing rule categories or sets of billing rules to decision models. A decision model will contain all the conditional evaluation rules required to raise the relevant charges.

Decision Models

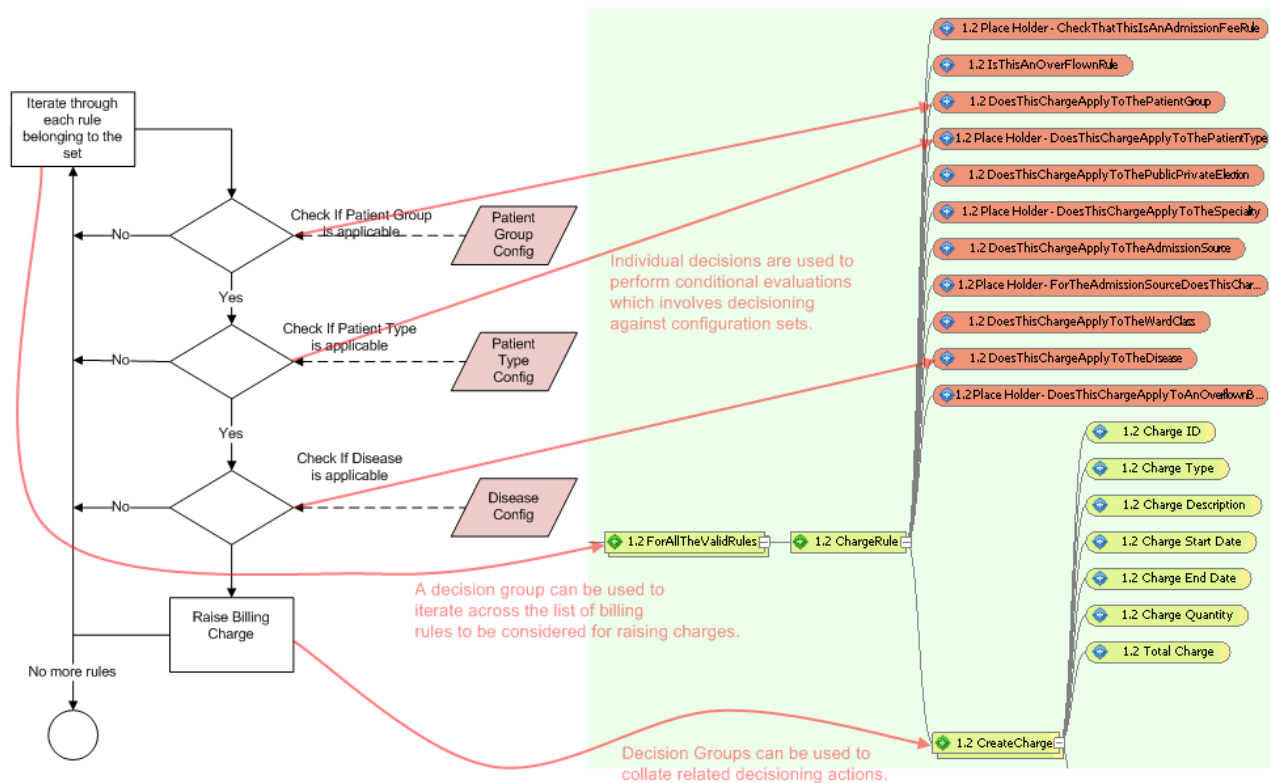
- ⊕ s1-2 IP - Admission Fee
- ⊕ s1-3 IP - Maintenance Fee Idiom
- ⊕ s2-1 OP - Attendance Fee
- ⊕ s6-1 Pathology Services
- ⊕ s7-1 Obstetric Package

An Idiom Decision Model will be created for each billing rule set or category.



Rules Implementation

- Within each decision model will be sets of decision groups to iterate through the rules or group sets of conditional evaluations together.
- Conditional evaluations will be performed by decisions and the grouping/layout of the decision groups and decisions with the decision model will determine the workflow of decisioning.



Rules Implementation

- Configuration for set type evaluations which reside inside of tables will use the meta language that we defined in the model.

