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Delivering outcomes for better Health services

Autocoding- Trial results

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Why do we want to increase the use of automation in coding?

- The importance of measuring activity

- Our limited clinical coding workforce

- Limited education options

- Subjective bias or confirmation bias of the experts

- Variable skill and experience

- Incomplete or incorrect documentation rates

- The inequity of access to skilled coders

- Variable and complex standards interpreted in different ways

- Health is the biggest cost to our society and the most important one

- We have capability, with expanding AI interpretation of documentation

- The current state is not sustainable or logical

The future of classification

Three trials in three countries

- Using structured CIS data

- Unstructured data from electronic and paper scanned records

- Trained by human experts

  - Model integrates multiple data sources

  - Populate rules consistent with how humans review the records

  - Measure and match

  - Automate high matches

  - Over 90% accuracy to final DRG over 60% exact match for all codes

- The coder can iterate rules over time in real time to meet changing standards and increase capture and more volume

- Proven accuracy, exceeding human accuracy

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3 Coding Pilots

We have tested our AI coding automation solution with different data sources, from multiple hospital sites, those with a full EMR, partial EMR and no EMR, with scanned records. Tested in three countries. Taking in discreet data and unstructured data

1. Australia – 1 month of data from specialist cancer information system **included**– Discharge summaries, Prescription summary, Treatment plan and phase, Medications, Pathology and radiology (most recent only), Demographics, including MRN, DOB, gender.

2. United Kingdom– 1 month of EMR documentation (Cerner), testing accuracy for 17 high volume HRGs

3. New Zealand – PDFs of complete patient episodes including some administration system outputs and miscellaneous paper records from 3 different hospital sites, with no standard formatting, and majority handwritten documents.

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Methods

Receive data as different files or one merged file from multiple sources
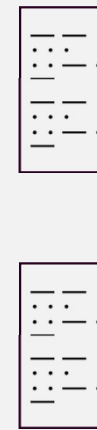
- match and merge the files into 1 importing into RippleDown to ensure all patient information was present in a single case

Ingested into RippleDown using the RippleDown CSV importer, scanned records interpreted using ML prior to import
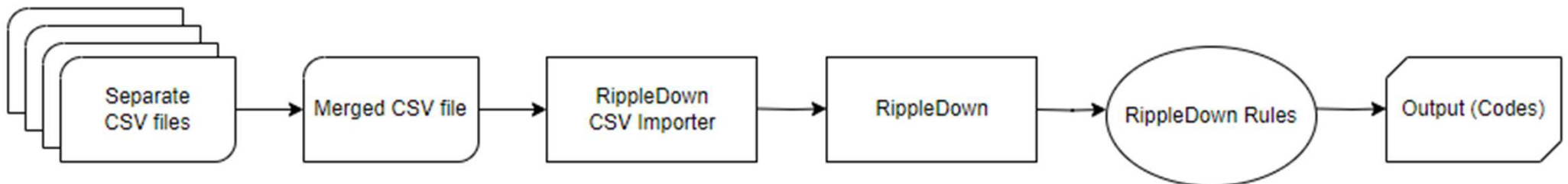
Sorted Splits   Merged   Sorted File

Separate CSV files → Merged CSV file → RippleDown CSV Importer → RippleDown → RippleDown Rules → Output (Codes)

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Why is our solution successful?

RippleDown® Rules

Expert Provides Initial Rules Set → **New Example / Case Presented to Ripple Down Expert** → **Case is reviewed** → **Case is correctly actioned** → **New Rule is added to Rule Set to cover example case**

Case does not fit established rule

Case is exception to the rule

The knowledge base learns from the human subject matter expert and becomes more sensitive and accurate over time to minimise the amount of human input required and maximise the level of automation.

Repeat steps with additional examples until the desired level automation and accuracy is achieved over multiple scenarios.

- RippleDown technology, AI curated expert system

- Learns from real patient data

- Can be adjusted easily by experts to deal with multiple Coding Standards, and local interpretations

- Can change easily with standards

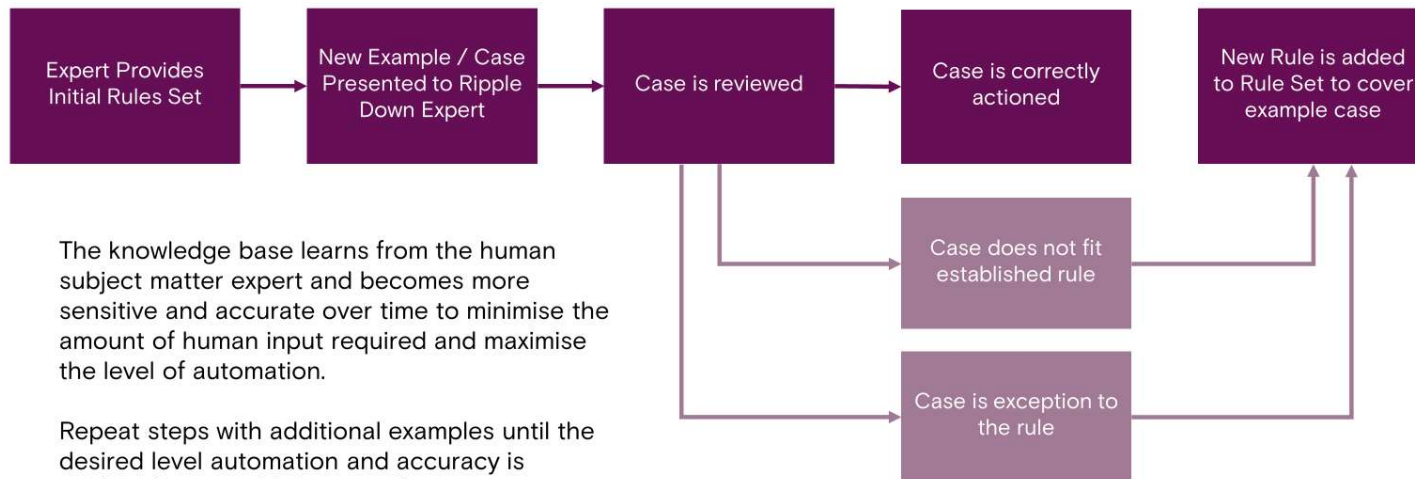- Has unlimited rule capability

- Changes in real time

- Automated and partially automated pathway

- Data system agnostic

- Language agnostic

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Documents types

- Anaesthesia Records
- Clinical Notes
- Discharge Summaries
- Emergency Medical Assessments
- Inpatient Care Plans
- Maternal Screenings
- Nursing Progress Notes
- Operation Records
- Pathology Results
- Patient Examinations
- Post Anaesthesia Records
- Pre-Operative Checklists
- Pre-Procedure Notes
- Procedure Notes
- Progress Notes
- Radiology Results
- Social Work Notes
- Ultrasound Results

- Documents are grouped
- Groups can change over time as we discover any new documents
- The rules will be able to point to the specific document type used to code an event.
- Your coders may identify other documents they use
- Allows us to create a hierarchy of document value

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Australia –findings for oncology day stay cohort (partial EMR)

- One DRG considered in trial R63Z Chemotherapy, and

- Primary Diagnosis Z51.1 Pharmacotherapy session for neoplasm

  - **Detection: 99.7%**

  - **Accuracy: 97.6%**

  - **Misclassification: 2.4%**

  - **Precision: 97.3%**

  - **Sensitivity: 99.7%**

  - **Specificity: 89.4%**

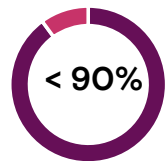| Code Matches	Number of Cases	Percentage of Cases (%)	Description
Exact Match	214	60%	Where coded output was matched 100% to human interpretation

United Kingdom – Proof of concept with full EMR

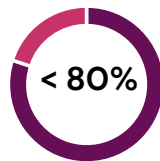2500 records were complete

17 HRGs considered for trial

480 diagnosis and procedure codes identified in this group

100%
9 HRGs coded at 100% accuracy

< 90%
4 HRGs identified between 90% and 99%

< 80%
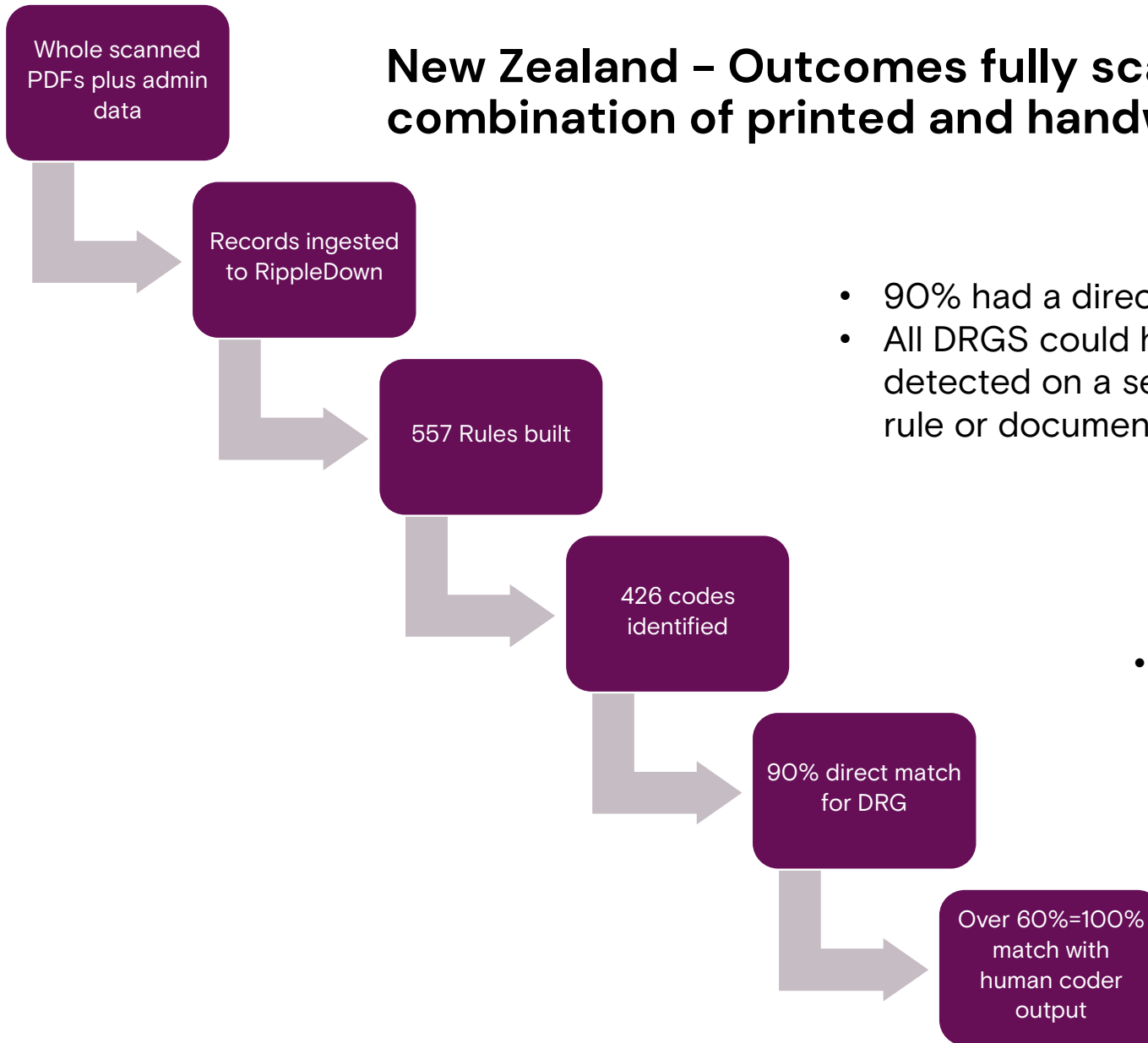4 HRGs identified between 80% and 89%

Time saving of 60 hours per month

4.3% of cases successfully auto coded for October 2021

The HRG list equates to 7% of all episodes for 2021

	HRG code	Accuracy
1	**PD12C** – Paediatric, Asthma or Wheezing	100%
2	**PD15D** – Paediatric Acute Bronchiolitis	92%
3	**BZ34C** – Phacoemulsification Cataract Extraction and Lens Implant	99%
4	**PB03Z** – Healthy Baby	80%
5	**NZ19B** – Ante-Natal Major Disorders	85%
6	**PW20C** – Paediatric Fever of Unknown Origin	100%
7	**PR03C** – Paediatric Febrile Convulsions	100%
8	**PJ66C** – Paediatric, Rash or Other Non-Specific Skin Eruption	100%
9	**PC63D** – Paediatric, Head, Neck or Ear Disorders	83%
10	**PF21B** – Paediatric, Infectious or Non-Infectious Gastroenteritis	100%
11	**CA35** – Grommets	100%
12	**LB56** – Circumcision	100%
13	**HN45 A/B/C** Minor Hand Procedures for Non-Trauma – carpal tunnel syndrome	100%
14	**CA60** – Tonsillectomy	100%
15	**FF62** – Inguinal hernia (prosthetic mesh repair)	98%
16	**HN22** – Knee Replacement	83%
17	**HN12**– Hip Replacement	93%

New Zealand – Outcomes fully scanned record, with combination of printed and handwritten text

Whole scanned PDFs plus admin data

Records ingested to RippleDown

557 Rules built

426 codes identified

90% direct match for DRG

Over 60%=100% match with human coder output

- 90% had a direct match DRG on first pass
- All DRGS could have all been correctly detected on a second pass with one additional rule or document to equal 100% match

- 60% had a direct match for all codes by coder output

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Code	Description
F62B	I500 Congestive heart failure
T62B	I214 Acute subendocardial myocardial infarction
V60A	D649 Anaemia, unspecified
F10B	F103 Mental and behavioural disorders due to use of alcohol, withdrawal state
G02C	F102 Mental and behavioural disorders due to use of alcohol, dependence syndrome
K62A	Z602 Living alone
E75A	K8040 Calculus of bile duct with cholecystitis, without mention of obstruction
E62A	S640 Injury of ulnar nerve at wrist and hand level
F42B	S562 Injury of other flexor muscle and tendon at forearm level
F17B	S565 Injury of other extensor muscle and tendon at forearm level
E74B	S619 Open wound of wrist and hand, part unspecified
H62B	C001 Malignant neoplasm of external lower lip
H08B	Z9222 Insulin
I10B	K37 Unspecified appendicitis
G04C	Q4332 Congenital intra-abdominal adhesions (bands)
G70A	J101 Influenza with other respiratory manifestations, other influenza virus identified
N62B	J47 Bronchiectasis
C62B	E876 Hypokalaemia
I77B	R268 Other and unspecified abnormalities of gait and mobility
M60B	Z290 Isolation
I09B	J13 Pneumonia due to Streptococcus pneumoniae
J13A	Z450 Adjustment and management of cardiac device
E70B	J22 Unspecified acute lower respiratory infection
D14B	N179 Acute kidney failure, unspecified
B07B	N184 Chronic kidney disease, stage 4
O60B	R42 Dizziness and giddiness
D40Z	I8020 Phlebitis and thrombophlebitis of deep vessels of lower extremities, not elsewhere classified
G05A	J987 Respiratory infection, not elsewhere classified
J07Z	O82 Single delivery by caesarean section
T63B	D509 Iron deficiency anaemia, unspecified
X62A	Z370 Single live birth
F60A	O321 Maternal care for breech presentation
J06B	Z301 Insertion of contraceptive device
Y62A	O2442 Diabetes mellitus arising during pregnancy, insulin treated
J08C	E877 Fluid overload
Y02C	I959 Hypotension unspecified
F72B	K590 Constipation
X07B	R33 Retention of Urine
F75B	Y26 Exposure to smoke, fire and flames, undetermined intent
H64B	Y929 Unspecified place of occurrence
I69B	T3100 Burns involving less than 10 per cent of body surface, less than 10 per cent or unspecified
F76B	T273 Burn of respiratory tract, part unspecified
G10B	T202 Partial thickness [blisters, epidermal loss] burn of head and neck
Q61A	T2221 Partial thickness [blisters, epidermal loss] burn of shoulder and upper limb, except wrist and hand, forearm and elbow
H63C	T232 Partial thickness [blisters, epidermal loss] burn of wrist and hand
X60B	A419 Sepsis, unspecified
D63B	D500 Iron deficiency anaemia secondary to blood loss (chronic)
O01C	F101 Mental and behavioural disorders due to use of alcohol, harmful use
P68D	K922 Gastrointestinal haemorrhage, unspecified
O61B	I859 Oesophageal varices without bleeding
96OZ	S299 Unspecified injury of thorax
O01B	S099 Unspecified injury of head
G48B	W03 Other fall on same level due to collision with, or pushing by, another person
D63A	Y9221 School
P68A	R509 Fever, unspecified
P65C	J210 Acute bronchiolitis due to respiratory syncytial virus
E66A	K047 Periapical abscess without sinus
G70C	X100 Contact with hot drink
T60C	R508 Other specified fever

D1 CS del
Hypo-pathway completed
Centil obs - completed
Formula feeding

Plan of care: -
- Routine NN Care
- Feeding support as required
-

Mother reports baby feeding well, passing urine and mec.
No triggers on NEWS chart.Baby check normal, NIPE done.

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An example of a case summary

HPC	Cycle 14 Day 1 BelaCarD – for Carfizomib/Dex today via PERIPHERAL cannulation Observations
PC	Multiple Myeloma – for chemotherapy
PMHx	1. Current Smoker; 30 pack years 2. High risk IgG lambda myeloma (17p deleted) – 2 x failed engraftments – date of transplant 1/12/17 – MEL auto
RxSummary	presented for Cycle 14 Day 1 BelaCarD. Observations stable. Peripheral cannula inserted in R) arm, bleeding and flushing well. Bloods fro
PostDCMxPlan	Next treatment date 09/11/2022
ClinObs	36.3911810S/7697% O2 SAT
Admission method	X-# Routine (other planned) admission
Admission Ward	Ward x
Discharge Ward	Ward x
DischargeDestination	Home/Other
PCEHR_DischargeDestination	Other/Home
Gender	Female
Mode of separation/transfer to	H – Home

Gestational Age	Gestational Age	Expected HCG (IU/L)		– 0.2–1 week	5–50
Report	CLINICAL NOTES: multiple myeloma borderline	SPECIAL CHEMISTRY	PROTEIN STUDIES – BETA 2 MICROGLOBULIN		SPECIMEN

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An example of a case

An example of data interpretation

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An example of coded output

```
DRG
R63Z Chemotherapy

Principal diagnosis
Z51.1  Pharmacotherapy session for neoplasm

Additional diagnoses
C90.00 Multiple myeloma without mention of remission

Morphology_Primary_site
M9732/3 Plasma cell myeloma

Supplementary Diagnosis
Z72.0 Tobacco use, current
U79.3 Depression
U83.2 Chronic obstructive pulmonary disease

Procedures
96199-00 Intravenous administration of pharmacological agent, antineoplastic agent
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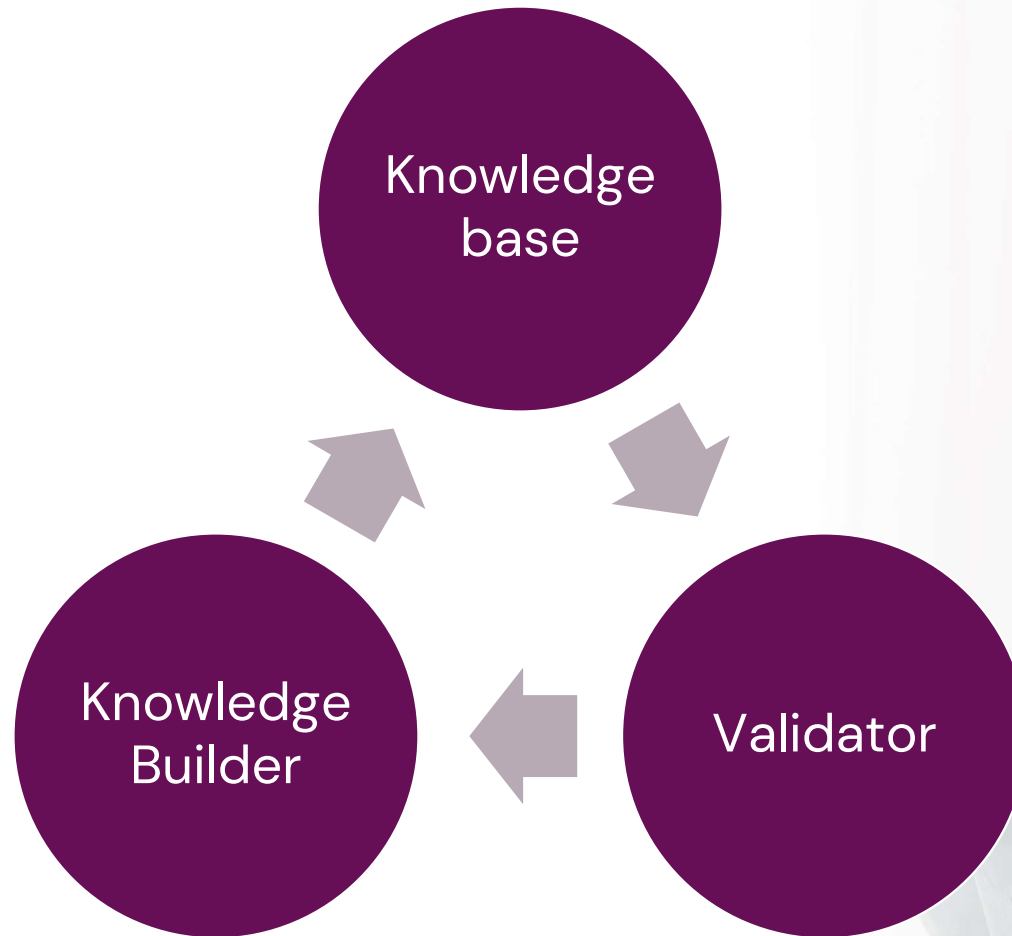
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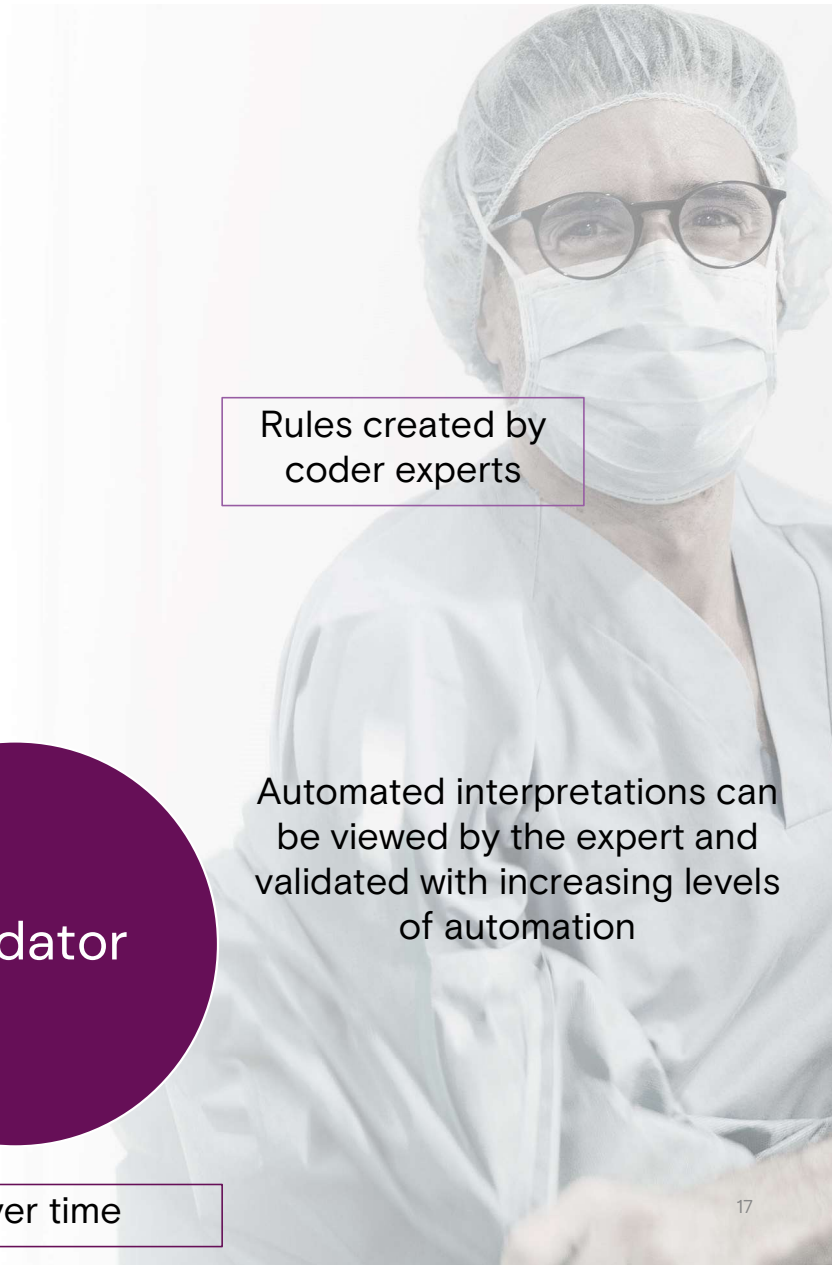
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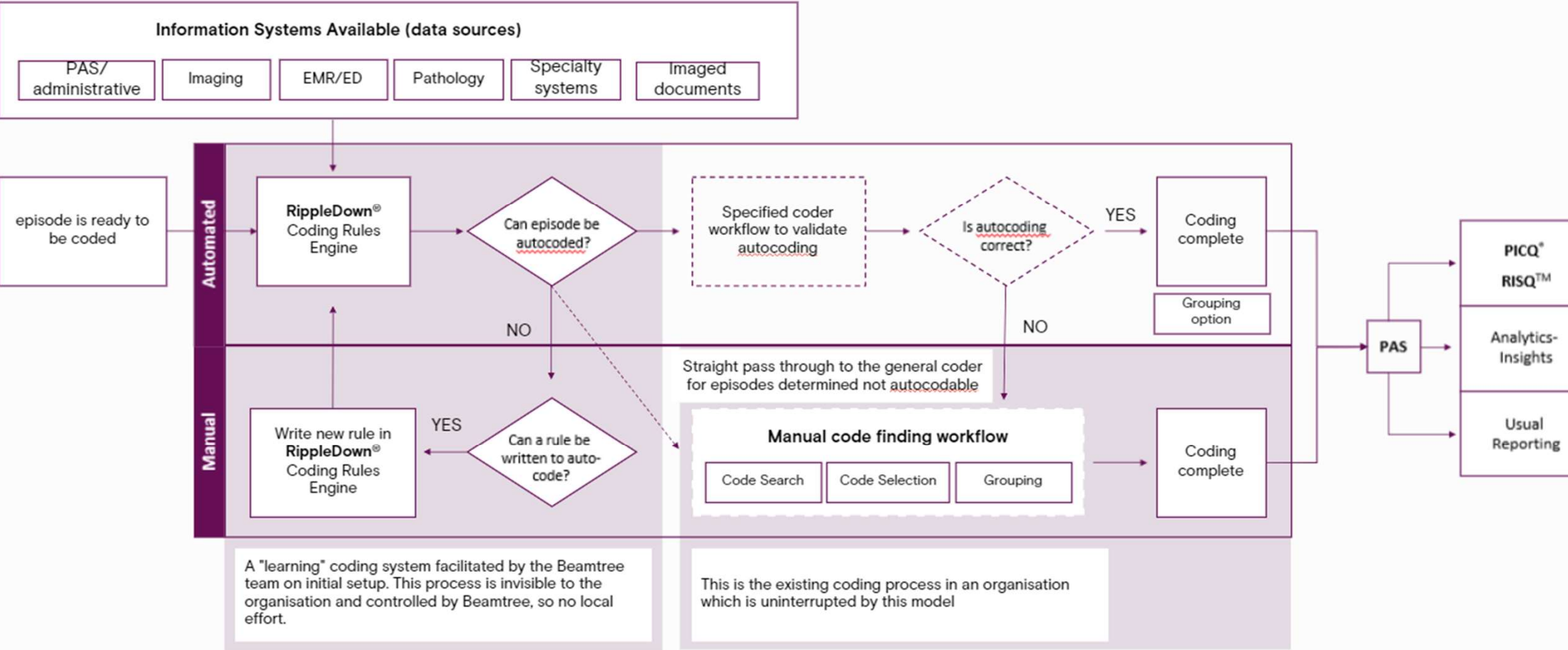
Take home messages

- Coders are a valued and scare resource

- Coding can be automated, with the supervision of expert coders

- An AI expert system learns from doing, the more exposure the more can be done

- 80/20 rule

- An AI curated expert system can be as accurate and specific in up to 60% of the coding requirements right now.

Why wouldn't we seek to automate a system to ease the burden of classification?

Creating a Better Future for Health

A classification enables the health care system to understand the healthcare activities it undertakes, the type of patients who benefit from such activities and interventions, and the resource use required to deliver optimal patient care.

Variation and change are necessary in order to maintain clinical validity, and reflect changes in clinical practice and technology.

A rigorous and effective casemix currency can make a significant difference to health delivery planning internationally and can be used to provide the basis for delivering local improvements in patient care

Technology can enable a more efficient collection, analysis and interpretation of care than ever before

At Beamtree it starts with better data and ends in better care   '**better has no limit**'.