# Annotated Outline of the Neurological Work-up

~

Pietro Mazzoni, M.D., Ph.D.

Department of Neurology
Columbia-Presbyterian Medical Center
New York

*2nd edition*

The following outline is the compilation of multiple sources' advice on how to perform a neurologic and medical work-up. I wrote it while I was a PGY3 Neurology resident at Columbia-Presbyterian Medical Center in 1998. The idea came at the beginning of my second rotation as senrio resident on the Neurology ward service. I met with the medical students to give them an introduction to how to evaluate a patient with a neurologic disorder. I had a deja vu sensation from having done the same thing a month earlier with the first group of students. So I decided that writing it down would save me some time in the future. The result is an informal resident-to-student guide on how to admit a patient to a neurology service. Many aspects are applicable to neurologic evaluations in clinic or in consultations, but the outline is written with the inpatient service admission in mind.

## Introduction

Clinical problem-solving in neurology is critically dependent on an accurate history and examination. What follows is an outline of a complete initial work-up, in the form of the admission note (also known as the "History & Physical") for a patient admitted to the hospital with a neurological problem. The outline is accompanied by notes on how to perform various parts of the neurological exam and comments on individual components of the H & P. The basic structure of the work-up also applies to the outpatient setting, although some details may differ.

The modern neurological exam is the result of careful neuroanatomical and pathological correlations made by neurologists over the past century. It contains screening tests that are efficient and sensitive, without compromising accuracy. The expert clinician is able to recognize an abnormality on exam, and study it in great detail using additional bedside testing. For many parts of the exam there are additional tests, enclosed in square brackets in this outline, that do not need to be done routinely, but can be used to asses and quantify a particular deficit in more detail. The exam components that are recommended for every patient (i.e. most of the ones that are not in square brackets) are chosen as especially sensitive (rather than specific) for certain deficits. For example, if the examiner quickly instructs, "Close your eyes, then point to the door, then touch your nose," and the patient performs this flawlessly, it is a good bet that comprehension is intact. On the other hand, if a patient makes an error, then careful testing of alertness and concentration will be needed to clarify any contribution from inattention. Then simpler commands (two-step or one-step) should be given to quantify the impairment of comprehension. Likewise, good performance of finger-nose and heel-shin excursion tests makes limb ataxia very unlikely. A poor performance, however, should be followed up with tests of check, past-pointing, and alternative tapping of heel and toe.

The main body of the outline contains the basic structure of the work-up. These are the elements that a neurologist should address, at least mentally, as part of the initial work-up of a patient with neurological problem. The information may arrive to you in any order (how many patients are regularly introduced to you with a diagnosis announced in the same breath as the chief complaint?), and many parts of the work-up may require a number of phone calls and other detective work before they are fully completed. The outline is meant to help you organize the clinical information in a logical way, so that as you gather clinical information you have a clear idea of what data is present and what information you may still want to collect to improve your impression. The notes in the margin are less formal suggestions and comments concerning specific parts of the work-up.

The outline is written for medical students, although other health professionals may find it useful. You are encouraged to take this outline with you into the patient's room and follow it as you take the history and perform the exam, and later as you write the admission note. There is no reason to commit the steps of the work-up to memory, as you will go through this type of work-up as a doctor so many times that you'll be able to do it in your sleep (which you may find yourself doing on certain nights on call!).

A few introductory tips:

1. There is no such thing as a complete neurological exam. Never try to do one. If you performed all the tests mentioned in small print even in this outline alone, you could spend more than 10 hours with a patient! What you should aim for is a complete neurological exam for your particular patient, as guided by the presenting problem. This may be accomplished by quickly establishing the parts of the exam that are normal and studying in detail the abnormal findings. One approach is to perform all the basic tests mentioned in larger print. Then use the history and any deficits identified by the basic tests to guide you to test certain systems in more detail.

2. You may have gotten the impression in your training that two parts of the work-up—the History of Present Illness and the Assessment and Plan--are to be written in beautiful prose drawn from the more creative regions of your dominant frontal cortex. As it turns out, the HPI and the A&P are also amenable to a "fill-in-the-blank" approach. Each has 3 elements, described in this outline. Recognizing at all times the "slots" you are filling with data may help you keep your thinking about the case organized, even as you plod through a stack of illegible notes in the chart. More importantly, it will help you assess the data critically, so that you may decide whether you actually agree with the diagnosis accompanying the patient.

3. Besides serving as a template for the admission note, this outline may also guide your oral presentation. However, never leave out an additional step before the oral presentation: go through the note and pick out (in your head or—more advisable initially—on a 3x5 card) single words that can remind you of each paragraph. Then drop the labels ("HPI,",

"Past history", etc.) and replace them with English syntax to connect the words you picked above. Never say: "Chief complaint: the patient is a 55-year-old woman with hypertension, high cholesterol, a history of tonsillectomy at age 5, and a stubbed toe, who presents with the chief complaint of weakness ascending up the legs over the past 2 days." If the patient indeed has Guillain-Barre' syndrome, her condition may worsen considerably before you are finished with such a wordy presentation! Try instead: "The patient is a 55-year old woman with ascending leg weakness over the past 2 days." The rule is: you have 7 minutes total (besides the numerous interruptions of the typical neurology attending): anything in those 7 minutes is up to you, and everything outside those 7 minutes will be confounded by your listeners' annoyance. Use your time to emphasize in detail the relevant parts of the work-up, and fly over the less important details. "On exam, the patient had an expressive aphasia, left hemiparesis, left hyperreflexia, and a left Babinski sign" is a perfectly acceptable length of an exam presentation, and will convey much more than the same information mixed with an unending list of the normal findings you elicited.

## Disclaimer

The material in this outline is not meant to be authoritative. There are far more definitive resources on the neurologic evaluation. If any statements in this outline are in disagreement with one of these sources, the more authoritative source is more likely to be correct. The content of this outline reflects clinical wisdom that was passed on to me verbally, and thus is subject to all the imperfections of this mode of knowledge transmission.

## Acknowledgments

My thanks go to Dr. Blair Ford at the Center for Movement Disorders at Columbia-Presbyterian Medical Center. He provided insightful comments and suggestions for this outline. Much of the material for the clinical comments consists of information (clinical tips and "pearls") passed on in clinical and teaching rounds by many attendings and residents at the Presbyterian Hospital and Harlem Hospital in New York City, and at the Massachusetts General Hospital and Brigham and Women's Hospital in Boston. In particular, the teachings of Drs. Alfred Bannerman, Robert Brown, John Brust, Stephan Mayer, Timothy Pedley, Lewis Rowland, Martin Samuels, Stephen Shafer, and Ann Young, in addition to many residents at the hospitals listed above, stand behind much of the substance of this outline. The approach of separating the formal outline (contained in the body of the text) from the practical tips and suggestions picked up on rounds, which are entered as margin notes, was inspired by the Manual of Introductory Clinical Medicine, by Macklis, Mendelsohn, and Mudge. In addition, we used information from the following sources.

## References

Aminoff, Simon, Greenberg. Clinical Neurology. Lange Medical Series, 1992.

DeGowin & DeGowin's Bedside Diagnostic Examination. MacMillan, London, 1987.

Macklis RM, Mendelsohn ME, Mudge GH. Manual of Introductory Clinical Medicine. Little & Brown, Boston, 1988.

Patten J. Neurological differential diagnosis. Springer-Verlag, Berlin, 1996.

Plum F, Posner JB. The Diagnosis of Stupor and Coma, 3rd ed., MacMillan, Philadelphia

## Format

The format of the outline is as follows.

## Section of H&P

**SYSTEM EXAMINED**

Part of system tested

Choices (description of what this paragraph should contain, or choices of phrases/descriptors for this part of the system)

Definitions

*How to do it*

Samples. These are sample ways to phrase certain findings (mostly given for normal findings).

Notes: these are suggestions, clarifications, or comments concerning some of the finer aspects of the H & P

# Neurology <Your Professional Title> Admission Note

## History

**ID & CC:**

- <Age & Gender>
- <Reason why pt is here to see you today>
- <Duration of symptoms>

**SOURCE:**

- <Pt/ Old chart/ ER chart/ Family member>
- <May comment on reliability of sources>

**HPI:**

*The HPI has 4 components: 1) a brief introductory sentence painting the pt's clinical background: relevant prior dx's, relevant risk factors, etc. 2) A full analysis of the chief complaint, including time course of its development and of all symptoms work-up, and treatment related to it. 3) A listing of the symptoms associated with the CC and of the course of prior diseases relevant to the CC. 4) A list of the pertinent negatives.*

- First line: Pt has <Only the PMHx and risk factors that are relevant to your eventual assessment>.
- "She was <well/ in usual health> until <date of start of chief complaint> when she first developed <gradual/sudden> onset of <mild/ moderate/ severe> <chief complaint>, <quality>, <location>, <radiation>. This <initial time course: waxing/ waning, constant, increasing, decreasing> and lasted for <gross duration>. It was precipitated by <precipitants>, worsened by <aggravating factors>, and relieved by <alleviating factors>. Negatives pertinent to the CC.

  *Do a full PQRST analysis of each symptom (Palliative and aggravating factors, Quality of the sx, Regional distribution or location of sx, Severity, Triggers and Time course).*
- <CC> was accompanied by <accompanying symptoms>. <Same analysis as for CC>.
- <Time course for every symptom or cluster of symptoms. Each time interval organized by Hx-PE-Labs-Studies-Impression at the time and what was done in terms of treatment or further evaluation. If pt spent time in a hospital (e.g. in Transfer/Accept notes), give time course of each problem, ordered by systems (Neuro-Resp-CV-Inf Dis-GI-GU-Heme-Endo-Musc-Skel-Derm-F/E/N-Dispo)>
- <Pertinent negatives for DDx raised by HPI.>

  *A list of negatives that tell the reader what the DDx is without naming specific diseases.*

  *DDx here refers to the DDx at this point, i.e. based on the history alone-- ignoring the findings on exam & studies that come next in the H&P.*

Every note in the chart needs a title, which should state: your specialty, your level in training (e.g. CC3, Junior resident, Attending), and the type of note it is (e.g. Admission Note, Progress Note)

Every sheet of your note must have the patient's name, today's date, and your signature.

The chief complaint is one of the most important parts of the history, and often the most difficult to write. The reason is that it primes your reader/listener -- who is usually a harried physician distracted by all sorts of other pressures -- for your eventual DDx. This is not cheating. Any physician will create a DDx in his/her mind automatically upon hearing the first sentence. So, although you will see a lot of variability in what doctors say in their first sentence (including skipping the chief complaint altogether), you might as well use it to focus the reader's attention on what you think is important.

However, note that actually saying the pt's dx in the CC is not productive, as it turns the presentation on its head and biases the reader with an interpretation. In the CC & HPI you want to bias the reader by organizing the facts in a certain way. All interpretation takes place in the assessment section.

As concerns race/ethnicity: one approach is to include it in the CC if it is relevant to your DDx; to include it in the first sentence of the exam if it is relevant to any part of the H & P (e.g. the variable appearance of skin rashes); to list it in the family history; and to exclude it entirely if it is completely irrelevant

In the Source section: The patient is the informant; you are the historian. Moreover, avoid judgments phrased to encompass the person's moral character (e.g. "the patient seemed unreliable"). Better to be specific: the patient seemed an unreliable informant.

The third element of the HPI (the “Pertinent Negatives” section) is the most difficult part of the HPI. Most textbooks and courses are organized by diseases. Very few books are organized by symptom complex. No textbook is organized by relevant negative symptom complex. This paragraph will thus continue to improve throughout your career, and in it your clinical acumen will shine. The paragraph is meant to contain in implicit form all the possibilities you have cleverly thought of, which other physicians, who wrote HPI's that are otherwise nearly identical, did not think of.

**PAST MEDICAL HX:**

- <List every disease & date of onset. If relevant, briefly mention current status of disease>

  E.g. Asthma. On inhaled steroids.

You may mix the past surgical history with the past medical history, or make them separate entries.

For children (or adults with a disease that might have originated perinatally or in childhood) , include the prenatal, perinatal, and developmental history.

For women with either a current problem that may be related to their gynecological history, or with an unrelated but significant gynecological history, include that history here.

**MEDICATIONS:**

- <At home>
- <On admission>
- <Current>

**ALLERGIES:**

- Include:

  What reaction occurred.
  MRI if pacemaker present;
  IV contrast if allergic to shellfish or iodine.

**FAMILY HX:**

- Anyone with: 1) similar HPI; 2) related Dx; 3) any of the major familial diseases.

  *CAD/ Stroke / Sz / DM / Mental retardation/ Cancer*

If multiple family members are affected, do a pedigree.

If no one is affected in the family but a familial condition is in the DDx, specify the number of relatives: writing "FHx negative" for an adopted person with no children can be misleading.

**PSYCHOSOCIAL HX:**

- Who does pt live with
- Present or past occupation
- Exposures

  *Prison, TB-infected people, STD carriers*
- Travel hx

  *Woods, etc.*
- Habits and drugs

  *Cigs - (compute pack years; if pt quit, include years since quitting)*
  *EtOH - (+/- CAGE qq)*
  *Illicit drugs - (IV use?)*

**REVIEW OF SYSTEMS:**

| | |
|---|---|
| Const. - | No fever/ shakes/ chills/ night sweats/ anorexia/ wt loss |
| Skin - | No rashes/ birth marks/ lesions |
| Head - | No headaches |
| Eyes - | No blurry/ clouded vision |
| Ears - | No hearing problems/ tinnitus |
| Resp - | No SOB/ cough |
| CV - | No chest pain/ palpitations/ postural light-headedness |
| GI - | No abd pain/ diarrhea/ change in stool color/ constipation |
| GU - | No dysuria/ urgency/ increased frequency/ incontinence |
| Heme - | No easy bruising |
| Endocr. - | No hot flashes/ temp swings/ hirsutism |
| Mus-skel - | No arthralgia |
| Neuro - | Headache/ dizziness/ vertigo |
| Psych - | No insomnia, crying, listlessness |

The Review of Systems should cover symptoms over the past few weeks, or chronic and worth noting but clearly unrelated to the present illness.

The "Neurological" section of the ROS should list neurological symptoms that don't relate to CC or HPI

## Physical Exam

- VS:
  T, BP, Pulse rate and pattern, RR, weight
- General:
  Constitutional status (WDWN/ cachectic), +/- ethnicity, gender, level of comfort (No apparent distress/ anxious, etc.)
- HEENT:
  Normocephalic, atraumatic
  No icterus
  No photophobia
  Oropharynx with pink and moist mucosal membranes
- Neck:
  Supple
  No carotid bruits
  [No Brudzinski 's or Kernig's sign]
- Chest:
  Clear to auscultation bilaterally
- Heart:
  RRR, S1, S2, no murmur/rubs/gallops
- Abdomen:
  Bowel sounds present; abdomen soft, nondistended, nontender, no palpable masses, no hepatosplenomegaly
- Genitalia:
  Normal adult male/female genitalia
- Rectal:
  Normal sphincter tone
  Prostate not grossly enlarged
  Stool brown, guaiac negative
- Extremities:
  No clubbing/cyanosis/edema
- Pulses:
  Carotid, Radial, Inguinal, Popliteal, Dorsalis pedis, Posterior tibial
  Present, absent, bounding, etc.; or use the 1+, 2+, 3+, scale
- Skin:
  Warm & dry. No lesions.
- Nodes:
  No cervical or inguinal lymphadenopathy

Strongly consider writing the finger-stick blood glucose (FSBG) here with the vital signs. It is almost as vital as the other signs, and it is often glossed over in the Labs section.

Trauma: check for raccoon's eyes, hemotympanum, Battle's sign

Neck tone can go here or in the motor exam. Especially important for meningismus, parkinsonism.

Kernig's = pain in neck on knee extension. Brudzinski = knee flexion when neck is flexed. May also enter it in the Extremities section

You don't need a reason to do a rectal-- it is part of the admission exam. You need a reason to justify not doing it (e.g. male under 50 y.o. here for a stubbed toe). If done by someone else on admission, however, you may quote that person's results instead (adding "per ER resident," or whoever did it, in parentheses)

Remember that quite a bit of neural tissue arises from the ectoderm: many (inherited) CNS diseases (e.g. neurofibromatosis, spina bifida) have skin manifestations. Vascular malformations (angiomas) can show up on the skin.

Also, weakness of any kind leads to decreased mobility: look for pressure ulcers.

## Neurological Examination

### MENTAL STATUS

Level Of Consciousness

- Alert/Lethargic/Stuporous/Comatose
  *Present pt with increasingly noxious stimuli; stop when the most complex behavior is elicited: introduce yourself (stop if pt introduces him/herself back) --> shout "what's your name?" --> tap pt gently on chest (stop if pt opens eyes & starts talking) --> tickle nostril, or cover face with sheet, or apply sternal rub (all these are very potent stimuli)*
  Alert = eyes open; for most patients: looks around, makes eye contact.
  Lethargic = in response to examiner's voice, pt can carry some sort of conversation or interaction with examiner.

Note that the terms lethargic, stuporous, etc. do not have a meaning as standardized as, say, the MRC motor power scale (0-5). Therefore, it is important to add a phrase describing the patient's response (usually the most complex behavior of which the pt is capable).

If sensory input might be cut off (e.g. in top-of-basilar stroke or in spinal cord transection), apply pain to supraorbital notch (= most rostral route of pain input) and not to sternum.

Alert: analogy to the house: "the lights are on" (not necessarily "someone's home"-- vegetative pts can be alert).

See Plum & Posner for details.

Level of consciousness drifts off after the stimulus disappears.

Stuporous = opens eyes & may say partially comprehensible speech with deep stimulation (pain); drifts off after a few seconds in spite of ongoing stimulation.

Comatose: eyes closed, No return to awareness in spite of sustained stimulation

Examples:
Alert
Stuporous: on sternal rub, pushes examiner's hand away with both hands
Comatose: extensor posturing on sternal rub

Orientation

To person, place, time

*What's the year and the month*

Concentration

*"Count backwards from 20 to 1." Record time taken. Stop pt if 30 sec go by or if pt makes more than 1 error.*

Counts from 20 to 1 in ___ sec.

*Alternatives:*

*"List the months (or weekdays) backwards."*
*Spell WORLD (or SAILOR) backward*
*"Look at my fingers when they move"*
*A detection task-- one of the purest tests of attention, though it still requires some communication abilities (verbal or by mimicry) to understand the instructions.*

May usually skip asking re: orientation to person. Suspect psychiatric problem if this is impaired.

Mental status abilities can be thought of as organized like a pyramid, with alertness and attention at the base and other cognitive functions above. If alertness or attention are impaired, the rest of the MSE becomes insensitive: do whatever you can, but remember that while a normal finding is helpful (lethargy does not produce a false positive normal language exam), any abnormal finding may be due to inattention. If in doubt, write "(confounded by inattention)" next to the abnormal finding.

Memory 1

- Ask pt to register the three words now; then ask for them after language testing.

*Remember these 3 words: "Eagle, button, and chair"*

One set of words is: Chicago, banana, 33. In Spanish: Chicago, banana, trenta-y-tres. Categories: a city (una ciudad), a fruit (una fruta), a number (un numero). Multiple choices: New York, Philadelphia, Chicago, Washington (same in Spanish); naranja, manzana, banana, pera; veinte-cuatros, cuarenta-cinco, trenta-tres, doce.

Pick words that you can prompt for by category (e.g. "The first word was a bird") and by multiple choice ("Was it finch, robin, eagle, or raven").

Language & speech

- Spontaneous speech

= Fluency, prosody, paraphasic errors, pressure

Fluency = number of words per unit time

Prosody = the musical aspect of speech (intonation, speed variations, volume, pitch). Used mostly to carry emotional & some semantic aspects of language.

Paraphasia = substitution of a speech unit (e.g. word, phoneme, meaning).

Semantic = substitution of a word with another word of a different meaning

Literal = substitution of a word with a similar sounding one of unrelated meaning.

*Listen to pt's speech during hx. This should reveal 3 components above if present.*

*More formal fluency test: Ask pt to list category items (e.g. "say all the animals you can think*

*of" or "all the words starting with M"); count over 30 sec. Normal: at least 6 items per 30 sec.*

Speech fluent and prosodic

- Naming

*Name 3 objects and parts of objects*

Naming object parts is more sensitive than naming objects alone

- Repetition

*Say "The train arrived into the station over an hour late"; "They thought John was the one to help today"*

Use a sentence with several prepositions and conjunctions. These (the small parts of speech) disappear first in mild deficit. I personally avoid "No ifs and or buts" because in this sentence these small words are nouns, not conjunctions.

- Comprehension

*"Close your eyes, open your mouth, and point to the ceiling"*

*Alternatives:*

*Other 3-step commands: give pt 3 cards; "take 1 card & put it under pillow; give the second to me; keep the third in your R hand"*

Give this triple instruction first and fast. Most patients with intact comprehension will start doing task just as you finish the instruction and perform it correctly on the first try. If so, this is often a good enough screen for comprehension deficits if there are no other reasons to suspect a language problem.

- Reading

*Show the pt a written command ("Close your eyes") and say "Read this out loud and then do what it says"*

Note: testing reading requires several repetitions of the instruction, even in people with normal language. I don't know why.

- Writing

*"Write a short sentence, any sentence"*

Speech fluent & prosodic, w/o paraphasic errors.
Intact naming, repetition. Follows 3-step commands.
Reading & writing intact
Spontaneous writing intact

Writing own name does not count as writing (an automatic movement that's a poor assay for language).

If a deficit is found, you may want to look for peculiar dissociations: spontaneous vs. dictated vs. copied written language

If pt has hemiparesis, ask pt to write with the other hand (handwriting may suffer, but language should not)

Always check writing when a dominant hemisphere lesion is suspected: it may be the only part of language that's affected (this is not academic: language dysfunction almost always suggests cortical damage, raising your suspicion for an embolic stroke and making you get that EKG yourself, if it wasn't yet done, to rule out atrial fibrillation)

Memory 2

- Long term

*"List the current president and the 4 previous ones"*

*"What kind of trouble did Nixon get into?"*

*"What happened to JFK?"*

Almost everyone knows he was killed, but you can ask for decade- year- month- day (11/23/63) & state- city (Dallas, Texas) to assess t he severity of the deficit.

*Alternatives:*

*Questions are better if tailored to pt's background:*

*Who was Trujillo? (ex Dominican Republic president/dictator)*

*Where was Malcom X assassinated (in the Audubon theater across from Babies' Hospital)*

*Who does Michael Jordan play with? (Chicago Bulls)*

*Who was Rosa Parks (African-American woman who sat on whites-only bus seats & contributed to start of civil rights movement)*

*What was D-day? (start of Normandy invasion by Allied Forces)*

- Short term

*Repeat the 3 words I told you earlier*

Recalls 3/3 words at 3 minutes
(+- with prompting by category, +- with prompting by multiple choice)

*Alternatives:*

*Hide 3 pieces of money (dime, quarter, dollar) in three locations in room & ask pt to remember these locations. 3 min. later ask pt to point to the object's location: can ask for specific locations (where is the quarter?) or nonspecific if there is some impairment (where is the money?)*

If pt has aphasia, or if you suspect a dissociation between verbal and spatial memory, you may test spatial memory: hide 3 different coins around the room; then test recall of locations; then test recall of which coin is in each location. Using money is considered offensive by some, but it is very convenient, as most of us frequently carry coins with us. However, any object can be used.

Calculation

*How many quarters in $1.75*

*You buy a $1.35 ice cream cone and pay with $2.00. What's the change?*

$1.75 --> 7 qrtrs

Avoid multiplication--a test of rote memory more than calculation.

May use addition and subtraction to quantify degree of deficit. Record the number of digits pt can add/subtract.

Construction

*Copy design*

*Draw a clock*

Use a complex or 3-dimensional design (e.g. a cube)

[Extinction]

*Double simultaneous stimulation in visual , somatosensory, or auditory modalities*

[Neglect]

*Line bisection*

*Letter cancellation*

*Scene analysis*

(Examiner draws a circle +- the number 12, and asks pt to fill in the rest of the numbers starting with 1)

[Anosognosia, asomatognosia]

*Test for these if there is severe neglect or a known larger nondominant parietal lesion*

Some people prefer putting some tests of higher cortical function, such as neglect and extinction, in the sensory sections, just as apraxia is in the motor section. Your choice.

**[PSYCHIATRIC ASPECTS OF MSE (USE ACCORDING TO CLINICAL SITUATION)]**

[Mood and affect]

Mood = how the pt feels

*"How are your spirits?"*

Affect = how the pt seems to feel

*Report baseline affect, its range of variation, & its appropriateness:*

*Baseline: euthymic, depressed, elated, anxious, etc.*

*Range: full range, reactive, blunted, labile, Inappropriate/appropriate*

Depressed but reactive affect with occasional inappropriate jocularity

[Thought form & abstraction]

- Form:

  linear & coherent --> circumstantial --> tangential --> flight of ideas

  *Infer from pt's speech so far*
- Loose associations, neologisms
- Abstraction:

  *Analogies*

  *Aphorisms & proverbs*

  *Logic*

[Thought content]

- Delusions

  *Is anyone after you? Do you ever feel you are special or have special powers?*

- Illusions

  = misperceptions of real sensory stimuli

  *(e.g. a child on Zantac saw a balloon tied to the bed rail as a Teddy bear floating in mid-air)*

- Hallucinations

  = sensory perceptions in the absence of real stimuli

  *Are you seeing shadows or things/ animals/people that are not there, as though you saw a ghost.*

  *Do you hear voices that are not there, feel ants crawling on your skin)*

- Ideas of reference

  *Do people on TV talk about you specifically, or are there special messages about you in the newspaper?*

- Suicidal ideation
- Homicidal ideation

[Judgment & Insight]

*What would you do if you found a stamped envelope in the street?*

*What do you make of it all? (i.e. pt's course through illness)*

Remember that during the history you asked whether these things have happened in the past. Now you are asking whether they are occurring today (this especially applies to suicidal/ homicidal ideation)

**CRANIAL NERVES:**

[I: Olfactory]

*Smell cloves, coffee*

Avoid noxious smells (e.g. alcohol pad, mint candy) -- stimulate CN V (pain receptors), not CN I.

II: Optic

- VF by confrontation

  *Look for VF cuts (= blind areas that extend to the border of the VF and scotomas ("holes" in the VF, i.e. do not extend to VF border)*

  *Practice finding the pt's blind spot by matching it to yours. Optic neuritis can enlarge the blind spot.*

- Visual acuity in fovea

  Light detection --> motion detection > finger counting > 20/200 > 20/20

  Visual fields full by confrontation

Use pinhole if pt needs glasses but they are not there. To make a pinhole: puncture a piece of paper several times with a pin. Multiple pinholes are equivalent to one (in removing the need for a lens to focus light), but provide a brighter image.

- Fundi

  Disc color, pallor, edge (raised/flat)
  Vessels
  Retina (hemorrhages, cotton-wool spots etc.)

  Fundi: discs yellow with sharp borders; no AV nicking; no hemorrhages

Look at the fundi of every patient you admit to the hospital, especially light-eyed people (they tend to have larger pupils). There is no other way to become comfortable enough with fundoscopy to actually make decisions based on what you see.

- [Color desaturation]

  *Compare pt's perceived brightness of red object in both foveas and in periphery vs. fovea. See "red-brown" desaturation in optic neuritis (pt reports bright red changing to brown in the affected eye or in the VF periphery).*

III, IV, VI: Oculomotor, Trochlear, Abducens

- Eye movements
- Nystagmus
- Upper eyelid opening
- Pupils

Eye movements full without nystagmus. PERRL.

Have pt look at something far away when testing pupils. This removes any constriction due to accommodation and maximizes the excursion of the pupil's constriction when you shine light onto it.

V: Trigeminal

- Facial sensation
- Masseter & temporalis

*Test light touch (+- temp & pinprick) in divisions V1, V2, V3*
*Test corneals*
*"Clench your teeth." Feel masseter.*

Eye movements full with no nystagmus
Facial sensation intact to light touch bilaterally. Brisk corneal reflex bilaterally
Strong mastication muscles

Keep your finger at arm's distance and always have pt sit up at least at 45 deg when testing eye movements.

Ptosis: upper eyelid covers part of iris. Normally the upper eyelid grazes the upper iris margin in most gaze positions.

Do not confuse ptosis with facial weakness on the opposite side. With facial weakness, it's the lower lid that's abnormal: you see sclera between the lid and the iris (normally you don't).

The abbreviation EOM (for extraocular muscles) seems to have generated the curious expression "extraocular movements." Although strictly an extraocular movement is a movement of anything but the eye (an arm movement, perhaps), this phrase is used to mean eye movements, or ocular movements. Another explanation is that it stands for "External Ocular Movements," to distinguish eyeball rotation from intrinsic eye movements such as pupillary constriction.

VII: Facial

- Facial power

*"Raise your eyebrow. Shut your eyes tight, as if you had soap in them. Show me your teeth."*
*Compare lower eyelid height, nasolabial fold depth, mouth corner angle on L & R sides*
*Observe natural smile. Sometimes an asymmetry in natural smile (mediated by temporal pathways) is dissociated from the forced smile (mediated by frontal pathways), and vice versa.*
*To elicit a natural smile, try asking "what would you do if you won the lottery?" It works.*

Facial power: full for frontal, periorbital, cheek, and perioral muscles, platysma

Remember that the corneal reflex has an afferent (CN V) and an efferent (CN VII) component

Spontaneous smile (say something funny to elicit it): temporal lobe pathways. Forced smile (show me your teeth; the type of smile you don't want when you take someone's picture): frontal pathways.

VIII: Vestibulocochlear

- Hearing

*Whisper a nonsensical phrase in each ear, while rubbing fingers in opposite ear to mask hearing on that side.*
*If any abnormality is found, also check:*
*Rinne*
*Weber*

If the phrase is weird or funny (e.g. green & blue potatoes), then the pt's smile will quickly tell you that she heard you, saving you the time to have the pt repeat the phrase.

- Equilibrium

*[Tested below under "Coordination"]*

IX, X: Glossopharyngeal, Vagus

- Palatal & pharyngeal musculature

*"Say Methodist Episcopal, or Columbia-Presbyterian Medical Center, or Baby hippopotamus, or Newly laid linoleum, or Ulster constabulary"*
*If dysarthria is found, ask pt to say "pa-pa-pa, la-la-la, ga-ga-ga". Each phrase respectively puts emphasis on labial dysarthria (CN VII), lingual dysarthria (CN XII), and palatal dysarthria (CN IX, X)*

A good screen for dysarthria

*"Say Ahhhh." Look for lateral displacement of uvula, indicating a weaker palate on the side opposite the uvula's deviation.*
*Look for pooled secretion (indicating impaired swallowing)*
*Ask pt to swallow a few sips of a liquid. Stop if pt coughs (proving some degree of oropharyngeal weakness or incoordination). Change diet order if so.*

Palate elevates bilaterally; no dysarthria. No pooled secretions

*Check cough*

Have pt look away from you while checking this.

XI: Spinal Accessory
- Head turning
- Shoulder lifting

The left sternocleidomastoid, controlled by the left hemisphere, turns the head to the right (one of the few muscles powered by the ipsilateral hemisphere) (true? I've been challenged on this without complete resolution).

XII: Hypoglossal
- Tongue protrusion

Tongue midline
Sternocleidomastoid, trapezius with full power

**MOTOR**

*First, observe the musculature*

Muscle bulk
- Normal/ atrophy/ hypertrophy

Describe distribution of atrophy or hypertrophy.

Normal muscle bulk

Abnormal movements
- Tremor, myoclonus, fasciculations, clonic movements, chorea, ballismus, posturing

No abnormal movements

Tone

Flaccid = limb feels like (over)-cooked spaghetti
Normal = like spaghetti *al dente*
Rigid = (a.k.a. lead-pipe rigidity) constantly increased resistance at all speeds and in all directions
e.g. Parkinsonism
Spastic = (a.k.a. clasp-knife rigidity) resistance that varies with speed +- direction. Usually constant for a given speed (usually higher resistance at higher speeds)
e.g. weeks after a stroke
Paratonia = (a.k.a. Gegenhalten) resistance that varies with speed and direction pretty randomly, and that thus surprises you. Or may appear as an inability to relax: tone increases with more force exerted by the examiner.
e.g. after bilateral frontal lobe lesions, or in advanced dementia
Cogwheel rigidity
Feel like you are turning a ratchet.
Contracture
Joint's excursion range is truly reduced
Continuous muscular activity
E.g. tetanus

Testing tone: telling pt to relax is a good way to make anyone not relax. Instead, talk to pt casually while checking tone (but don't ask for any information that you want to remember—your attention must stay on the tone).

Arms: grab hand & move 2 or 3 joints (wrist, elbow, shoulder) at the same time in random directions at varying speeds. If the movement is predictable, the pt will help you and you may think tone is normal when it's not.

Legs: first do passive log roll (i.e. roll the leg at the thigh as if it were a log) for a few seconds, then suddenly lift thigh up off bed. If heel leaves the bed, tone is increased.

Power

- Screening tests: pronator drift, arm roll, piano playing

  *"Hold arms & hands in front of you & wiggle all fingers as if you are playing the piano."*

  *Or: have pt hold arms outstretched in front and open & close hands fast.*

  *Pronator drift*

  *Have pt roll forearms around each other, forwards & backwards. Look for differences in L & R arm radius*

These are pretty sensitive tests for weakness. As with rapidly alternating movements, the amplitude and speed of the movements indicate motor power. The regularity of rhythm indicates coordination (mostly cerebellar function, but also motor cortex).

- Confrontation

  *The following muscles should be tested in most patients:*

  *Upper extremity: Deltoid, biceps, triceps, wrist flexors, wrist extensors, grip, dorsal interossei*

| | Delt | Bc | Tc | WE | WF | Grip | DI |
|---|---|---|---|---|---|---|---|
| R | 4 | 4 | 4 | 4 | 4+ | 4+ | 4+ |
| L | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

  *Lower extremity: Iliopsoas, gluteus max, quadriceps, hamstrings, ankle dorsiflexors, ankle plantarflexors*

| | IP | Glu | Quad | Hams | DF | PF |
|---|---|---|---|---|---|---|
| R | 4 | 4 | 4 | 4 | 4+ | 4+ |
| L | 4+ | 4+ | 5 | 5 | 5 | 5 |

  *Additional muscles commonly tested:*

  *Neck flexor, neck extensors, hip adductors, hip abductors*

Remember: it's the pronation of the hand and forearm that indicates weakness, not the up or down drift of the whole arm.

The pronator drift is touted as the most sensitive test of arm weakness. It is, but only if you wait for 30-60 seconds.

Some people think the forearm roll is a more sensitive test for weakness than the pronator drift (you don't have to wait 30 sec to be sure in this test). Watch for rigidity, though, which will confound the result.

Power grading scale:

5/5 = examiner cannot overcome pt's resistance
4+/5 = can overcome with some difficulty (estimated strength 75% normal)
4/5 = moderately weak (estimated strength 50% normal)
4-/5 = severely weak (estimated strength 25% normal)
3/5 = moves against gravity but not against resistance
2/5 = moves but not against gravity
1/5 = minimal, barely visible movement

Power 5/5 throughout

[If walking on heels & toes is tested, you may record here your assessment of lower extremity power based on those tests, instead of confrontation with examiner's arms]

If poor effort (due to generalized fatigue or pain) seems to confound the assessment, ask pt to give maximal resistance at the count of 3 for just half a second

A leg muscle with 4+/5 power may still be too strong to be overcome on confrontation testing, but will show up as a lower heel or toe in affected leg on heel or toe walking.

There is no 5-, 3+, 3-.

The expression "motor movements" is sometimes used. I have yet to see a non-motor movement.

- Rapidly alternating movements

  *"Tap your thumb & forefinger with big and fast movements"*

  *"Hold your hands up and turn them back & forth as if you are screwing in a light bulb"*

  *"Tap your foot on the floor (or against my hand) hard and fast"*

  *Shake your hands*

Rapidly alternating movement intact bilaterally

As mentioned above, these test power and coordination simultaneously.

When pt taps fingers or feet, have her do one hand at a time: if tested together, their frequencies are more likely to be similar (remember how hard it is to pat your own head and rub your belly at the same time). Moreover, severe difficulty with one hand is at times accompanied by mirror tapping movements in the hand that's supposed to be still.

- Fine movements

  *"Tap each finger in sequence against your thumb"*

Fine movements intact bilaterally

A sensitive test of corticospinal tract function

[Praxis]

*Perform complex movement sequences:*

*Show me how you would salute, strike a match, comb your hair, hit a nail with a hammer*

No apraxia

**REFLEXES:**

Deep tendon reflexes

- Commonly tested:
  Biceps, Triceps, Brachioradialis, Patellar, Ankle
- [Additional DTR's:]
  [Jaw jerk, Pectoralis, Finger flexors, Hoffman, Suprapatellar, Hamstring, Hamstring adductors]

Babinski (the plantar response)

*Rub gently along lateral aspect of sole and across its anterior portion. Watch the first movement of the big toe.*

["Release" reflexes]

Root, snout, suck, palmomental, grasp
Glabellar

Root, snout, suck present
Non-extinguishing glabellar
Glabellar extinguishes normally

**SENSORY**

Basic modalities

- Light touch, proprioception, vibration, temperature, pin prick sensation

*Test these in all extremities if you can. If you skip a modality for a given limb, record that in your note.*

[Romberg]

Tested below with stance and gait, but recorded here as it is a proprioception test

[Two-point discrimination]

*A sensitive test of somatosensory cortex function*

[Stereognosis]

*Recognize coins, keys by manipulation*

[Graphesthesia]

*Recognize digits drawn on palm or forearm*

**COORDINATION:**

Finger-to-nose
Heel-to-shin
[Alternating hand orientation (test for dysdiadochokinesia)]

*= slapping hand prone/supine*

[Tapping heel & toe]

*Have pt tap heel & toe in alternation on the same spot on the floor. Watch for speed, precision, & regularity*

[Checking]

*Ask pt to hold arms up half-flexed at the elbow. Pull on each forearm and suddenly release. If cerebellum is normal, the hand should stay where it is; if not, the hand will spring away toward the pt's face.*

Hoffman is NOT the equivalent of the Babinski for the upper extremity. It is analogous to the finger flexor reflex. However, its mere presence is a sign of hyperreflexia, to a degree that an upper motor neuron lesion should be suspected.

Forget the other toes when testing for Babinski: you should be busy enough watching the big one. Use a key (one from a previous apartment, to be kept with your neuro exam equipment and wiped regularly)

It is common lore that a neurologist can make the toe go up or down at will. This is because it is easy to elicit this reflex incorrectly.

Accepted ways to report this reflex:
Plantar response flexor (down) or extensor (up).
Toes down-going or up-going bilaterally.
Babinski response present or absent.

Less accepted format:
Babinski present (a smart-aleck neurologist may ask you how Babinski managed to get out of his grave so that he could be present; ignore him, or ask him if his mother used to tell him to go play outside)

Watch for withdrawal and triple flexion: they may be hard to distinguish from each other.

Release reflexes are also known as frontal release signs, though not everyone agrees that they localize to the frontal lobe.

Non-extinguishing glabellar = Myerson's sign. A sign of Parkinsonism.

Do not skip vibration: it is one of the earliest signs for most disorders of sensation.

Finger-nose: No real need to vary the position of your finger from trial to trial, or to repeat it 25 times. 2-3 trials suffice. If there is severe dysmetria, have pt move finger from his/her chin-- rather than nose-- to your finger, to avoid risk of pt poking his/ her own eye.

When you test checking, make sure you guard the pt's face with your other hand, so that pt does not hurt him/ herself. A safer version of this test is to push the pt's forearm toward the pt's face, and then suddenly release

[Past pointing]
Tracking

*Ask pt to make a pointer finger and follow your pointed finger as you move it suddenly and quickly from point to point in the air. Watch for overshoot, undershoot, and delays. These are signs of limb ataxia/dysmetria*

Past pointing is not brought out well by finger-nose testing. Ending up in the wrong spot on finger-nose is dysmetria, not past pointing (unless deviation is to one side and constant). A better test for past pointing is to have pt touch your finger, then point up to ceiling, then touch your finger again. Then repeat with eyes closed. A systematic lateral error on returning to your finger is past pointing.

**STANCE & GAIT**

Stance

- Base: narrow/wide
- Steadiness
- [Retropulsion]

Romberg

*Stand with feet touching each other and arms at your sides. Close your eyes. Romberg is positive if there is significantly more swaying with eyes closed compared to eyes open.*

Test is very insensitive if there is also ataxia or dysequilibrium (i.e. if pt is unsteady even with eyes open).

A very mildly positive Romberg is one in which the ankle tendons become visibly active once the eyes are closed. This suggests that proprioception is mildly impaired, requiring constant adjustments by the ankle muscles to maintain posture.

Gait

Always look for the following 5 parameters of gait. Then choose the summary adjective (ataxic, hemiparetic, Parkinsonian) based on these parameters, not on intuition.

Additional features of gait: propulsion (festination), gait freezing, hyperkinetic (myoclonic gait)

- 1. Base: narrow/ wide
- 2. Speed: normal/ slow
- 3. Stride: full/ short/ shuffling/ tentative/ shallow/ circumducted
- 4. Cadence: regular/ irregular/ slower on R or L
- 5. Steadiness: steady/ unsteady

Narrow base if the distance separating the two heels is less than the length of the patient's feet (i.e. look at shoe size).

Ataxic gait = wide base, slow speed, tentative stride, irregularly irregular cadence, mildly- moderately unsteady

Hemiparetic gait = narrow base, slow speed, short, shallow, and circumducted R stride, regularly irregular cadence

- Tandem
- (Don't forget to check:
  Romberg here, & record it here or in sensory section;
  Walking on heels and toes; record it in power section of motor exam)

Tandem walking; one of the most sensitive tests of steadiness.

[Specialized tests and findings:]

- [Rising from chair with arms crossed]
  Tests proximal leg weakness
- [Pull test]
  Tests postural reflexes in suspected parkinsonism
- [Retropulsion]
  See in normal pressure hydrocephalus, progressive supranuclear palsy
- [Lateropulsion]
  See in vestibular & cerebellar damage

Always have a wall or a closed door behind you when you do the pull test—don't count on being able to keep a patient from falling by yourself.

## Labs:

Standard admission labs include:

- CBC with differential
- PT and PTT
- Chem. 7
- Liver profile (TP, albumin, direct & indirect bili, Alk phos, AST, ALT)
- Ca, P, Mg, Uric acid
- CK and LDH
- Cholesterol
- Urinalysis

Thyroid hormone imbalances can cause a variety of neurological syndromes. Remember that a thyroid panel consists of TSH, T4, T4 uptake, and FTI (which is calculated). Very rarely is T3 needed, and only after the other numbers are obtained. If the TSH is normal, you can usually ignore the other numbers.

**ECG**

*Rhythm- Rate-Axis- Intervals-P waves- QRS (Hypertrophy)- Ischemia (QRS, ST segment, T waves)*

Look for arrhythmia, especially atrial fibrillation, in patients with stroke.

**CXR**

*Mnemonic for reading: TLOPDACL*
*Technique- Lines- Osseous structures- Pneumothorax- Diaphragm level- Aorta- Cor- Lungs (vessels & parenchyma)*

Stroke—> dysphagia—> aspiration pneumonia

**HEAD CT**

*Assess for:*
*Symmetry, Hemorrhage, Lucencies, Hydrocephalus, Edema, Mass effect (midline shift), Cisterns, Sulcal effacement, Grey-white junction, Enhancement with contrast*

Don't forget to check bone windows and blood (subdural) windows if head trauma occurred.

## Assessment and Plan:

The first paragraph of the Assessment is not just a summary but a translation at multiple levels.

First, you translate the patient's everyday words (short, German/Anglo/Saxon-derived English words) into medical terms (many syllables, lots of Y's, usually derived from Latin and Greek). "Feeling weak all over" becomes "fatigue." Having increasing trouble running, then going up stairs, and then having knees buckle becomes a "progressive paraparesis."

Second, you filter and group all findings (historical, exam, labs) into syndromes. Sudden loss of speech and dropping a glass of water by a man who had stopped taking BP meds and had blurred vision, becomes "aphasia with hemiparesis in the setting of out-of-control hypertension."

Third, you order the various syndromes in the presentation according to the differential diagnosis (DDx) that's coming up 2 paragraphs later: the presenting syndrome (e.g. stroke), which usually produces the chief complaint, and which will have its own DDx; and then the accompanying syndromes, which carry their own dx or DDx (e.g. hypertension, pneumonia, diabetes, etc.)

What hurts?

- A summary (1-3 sentences) of the entire clinical presentation

  A very common format is:

  <Age>-y.o.... woman with multiple risk factors for <1-2 diagnoses that are at the top of your list>, who presents with <progressive/sudden/indolent> <symptom complex> in setting of <stressors>. Exam reveals <sign complex relevant to your DDx>. Studies are notable for <labs, ECG, imaging relevant to DDx>.

What's wrong?

- Localization

  "Involvement of L face, as well as arm and leg, suggests a lesion in a region where motor fibers to various body parts lie in close proximity. The deficit in fine movements, disproportionate to confrontation power, suggests that the corticospinal tract is affected. This lesion is likely in the R corticospinal tract between the internal capsule and the medulla (just above the decussation)"

- Pathophysiology

  "Hypertension puts this pt at risk for lipohyalinosis and

lipofuscinosis of the penetrating arteries, which would predispose to a lacunar stroke."

- Diagnosis +/- Differential Diagnosis

*Diagnosis: your impression of what the disease in question is at this point, based on all the evidence above.*

*Differential diagnosis: a list of diseases that could instead be the correct diagnosis, if—for example—some piece of data turned out to be inaccurate or misinterpreted. Whenever possible, add a line next to each diagnosis in the differential list stating items favoring this diagnosis or making it less likely.*

1. Ischemic stroke
2. Todd's paralysis

- Additional diagnoses

Hypertension
Diabetes

You have just crossed the line separating the two major steps of a medical work-up. The second step—using the summary of the presenting syndrome to localize a problem and make a diagnosis—is the easiest and could in theory be replaced by a computer algorithm. The algorithm humans usually follow is: how well does this clinical presentation match all the clinical presentations I learned in medical school? The first step—collecting the information from history, physical, and studies, and organizing it into a clinical syndrome—is the hardest and the most crucial, as it sets the upper limit of quality of your diagnosis. The accuracy of your interpretation can be no better than the accuracy of your clinical summary, which in turn can be no better than the accuracy of your primary data (which part of the history should you have ignored? Was that pronator drift really present? Should you have confirmed that reported MRI lesion yourself?). Thus your skill as a diagnostician has an upper limit set by the quality of your skill as a detective and organizer of the clinical information.

<u>How can we fix it?</u>

Plan by system and by problems

*Neuro-Resp-CV-ID-GI-GU-Heme-Endo-Musc-Skel-Derm-F/E/N-Dispo*

"Neuro: 1. CVA. Stroke is completed. No specific treatment. Call PT, OT. Prophylaxis: ASA, SQ heparin."

"CV: 2. HTN. BP now stable. No BP meds during first 3-4 days."

"CV: 3. recurrent palpitations. Raise the question of paroxysmal a. fib. Will discuss the possibility of Holter monitoring with team.

"Resp: 4. Aspiration prevention: HOB at 30 deg. Dysphagia II diet. Speech & swallow consult."

"Endo: 5. DM: Important to control sugar during acute CVA period. Chem strip qAC, qHS with SS insulin coverage."

"Dispo: 6. D/c planning: SW consult to help contact family. Expect partial recovery, with likely return to home with assistance."

While it's easy to continue improving your skills of interpretation throughout your life—by reading, through CME courses, etc.—most of your abilities in collecting the primary data are learned in medical school and residency. No book or video can ever substitute for an attending or resident listening with you to the same lung sounds and teaching you whether they are rales, rhonchi, or wheezes. So do not waste your $10/hour of medical education on reading or preparing sharp presentations on the role of the codon 178 mutation in the pathogenesis of CJD. Shadow instead your resident as she spends half an hour on the phone with the relative of a confused patient, and watch your attendings as they demonstrate the difference between ataxia and hemiparesis.

Always enter a diagnosis. If your work-up is adequate, a single diagnosis should be identifiable. You may qualify it with adjectives like "Probable," "Possible," or "Definite." "Rule out" (as in "R/o stroke") is a verb in the imperative form. It is not an adjective. R/o Parkinson's disease is not English unless you are commanding someone to exclude PD. You should not be giving commands to most people listening to your presentation (most of them have the power to make your grade slide).

There are two common ways to organize a plan: by systems and by problems. Each has shortcomings. It is sometimes useful to use both methods simultaneously, i.e. problems nested into systems.

_____

<Signature, Professional Title>
<Printed name>, <Level of Training>
Beeper # _____