The novice is confronted by a dizzying array of wiggly lines in a seemingly endless series of displays (or pages). At first the task seems impossible. How can I ever master this arcane science (or art, or a combination of both)? The secret, as in most complicated matters, is to break the EEG down to its essential elements. At the end of the exercise, one reassembles the parts to make a cohesive, understandable whole. We think of it as providing the ordering clinician with a well-wrapped package, bow and all. After all, the whole point of EEG interpretation is to help the clinician in his or her diagnostic quest.

ELEMENTS OF THE REPORT

One method of designing the EEG report breaks it down into five sections. Each is important in constructing an accurate picture of the patient’s electrophysiological status.

1. Clinical Information. This section should include the reason for the EEG request. The clinical information supplied by the clinician is often rudimentary; thus, the technician can be of assistance in obtaining additional information from the patient and/or the patient’s chart. If the patient had a recent seizure, say hours or a day before recording, it should be indicated here. If the patient is taking medications that have effects on the brain, they should be listed here. Examples include AEDs, psychotropic agents, and sedatives.

2. Conditions of Recording. In this section, describe whether the EEG is obtained under special circumstances such as after sleep deprivation or sedation. Then indicate the technician’s estimate of the patient’s state – awake, drowsy, sleeping, lethargic, comatose, etc. Other observations by the technician should be noted: the patient might have been restless, tense, confused, moving throughout, chewing, etc. If the record was obtained at the
bedside, or in an ICU or emergency room, it should be indicated here. All these features set the stage for understanding the following section.

3. Factual Report. Here, cerebral and non-cerebral events are described. We like to think that this section creates a word picture that more or less accurately lays out the important findings. Bear in mind that the report may be read by another electroencephalographer, and the record itself may be reviewed. Ask yourself, would such a peer reviewer come to the same conclusion? Another way to look at the issue is to ask, could I show a slide of this apparent spike or sharp wave at a national meeting without fear of being hooted off the stage?

4. Impression. State in brief summary the essential findings. For example: “This is an abnormal EEG demonstrating, against a normal background, an active spike focus in the anterior temporal region.” Or: “Abnormal EEG owing to mild, diffuse slowing along with intermittent right temporal delta activity.”

5. Clinical Correlation. This final section is perhaps the most important aspect of the report. It is a truism that the average clinician does not read the detail in the factual report, nor does he or she much care whether there is mu rhythm over the left central region. The clinician wants diagnostic help, if possible. The authors look at it this way: the factual report is important for electroencephalographers; the impression and clinical correlation is of interest to clinicians. So, one offers as much assistance in this section as possible. If the findings support a diagnosis of localization related epilepsy, say it here. If the findings are consistent with a metabolic disorder, or an acute infarct, then so indicate. This section is also the place to recommend further studies, if indicated. For example, if there is a minor temporal abnormality in a patient with probable complex partial seizures, you may suggest an EEG after sleep deprivation. Or, you might recommend an ambulatory EEG. Remember, serial studies are often helpful in certain situations (metabolic disorders, for example). The clinician needs your guidance in ordering immediate additional testing and how he or she should proceed in the future.

A further consideration is what to do when the record is studded with artifacts. Adhering to the principle of aiding the clinician, one should try to make some helpful statement even though, as a whole, the record is unsatisfactory for accurate interpretation. A few pages of relatively quiescent recording may reveal focal slow waves, or even a spike or two, giving some clue concerning the clinical problem. In these cases, one may recommend a repeat tracing when the patient is less confused or less restless, or perhaps a tracing after mild sedation, before a final impression is rendered.

HOW TO LOOK AT THE RECORD

In order to interpret the record properly, one must have clearly in mind the elements of a normal EEG. This establishes a template, against which all
deviations are to be compared. In the case of adults, recall that the normal waking record contains an alpha rhythm (with some exceptions as outlined previously), of maximum amplitude in the posterior quadrants. Beta activity is present fronto-centrally, in greater or lesser amounts. A few theta frequencies are acceptable if not lateralized. Little else is present. The response to hyperventilation may be marked in younger adults. Consistent lateralization is not permitted. A following (driving) response to intermittent photic stimulation is variable, but there should be no activation of epileptiform activity. The elements of drowsiness and sleep round out the template of the normal adult record.

It is sometimes useful to analyze carefully the first few interpretable pages or 10-second digital epochs. (Bear in mind that it may take several minutes before the patient settles down and relaxes fully.) This exercise is often time well spent. One may appreciate a hint of focality, or a hint of paroxysmal activity, or a possible asymmetry of background activity. In any event such analysis can set the stage for more rapid analysis of subsequent recording, providing clues on what to look for. Another hint that often pays dividends is to divide reading into vertical and horizontal appraisals.

Horizontal reading appraises and compares channels on the left side of the head with those on the right by scanning the record from left to right, choosing, for example, the left and right temporal leads followed by the left and right paracentral leads.

Vertical reading, scanning a particular segment of a second or so from top to bottom, concentrates more on particular waveforms and their distributions. A common problem with the beginner is that he or she becomes enmeshed in the complicated polyrhythmicity of the EEG by reading only vertically. This results in confusion and overreading. Overreading is a pitfall to be avoided (as, to some extent, is underreading), but more on this later.

Reading horizontally reveals abnormalities that may not be at all evident when reading vertically. In essence, horizontal reading reveals the broad picture presented by the EEG. For example, this is the best way to determine alpha asymmetry. One can easily determine alpha asymmetries, abundance, and irregularities. This is not evident with vertical reading. Unilateral or bilateral slowing also becomes more evident during horizontal reading. Importantly, the appearance of a new, paroxysmal frequency, diagnostic of an electrographic seizure, may not be evident with vertical reading. Many cases of recurrent electrographic seizures have been missed due to this oversight.

Now, look for pages where the patient is in his or her most alert state. Here is the point to analyze the alpha rhythm or the PDR. Is it well organized (that is, nicely rhythmic, devoid of admixed slower frequencies), or is it irregular or poorly persistent, or variable in frequency? Analysis of the PDR helps materially to determine laterality of any unilateral pathology. It is emphasized that if the patient is not maximally alert, no definite determination can be made of a PDR asymmetry.

Now, evaluate the beta rhythm. Beta offers a few clues to the presence of pathology. If asymmetric, it usually points to pathology on the side of diminished
amplitude. If abundant, it may reveal a drug effect. In any case, it is an important aspect of the basic or resting record.

The next task is to determine the presence of slow waves in the background. The slowing may be diffuse – that is, not lateralized and non-focal. Look for both theta and delta frequencies. Is there a small amount of intermittent theta activity? A great deal of theta? Are there mainly delta waves? A combination of the two? We sometimes look at the broad picture and try to decide if it belongs in the theta box or the delta box! Note that slowing may be more or less continuous, discontinuous, paroxysmal, rhythmic, or arrhythmic. There may be variable but inconsistent lateralization.

One problem is to determine at the outset whether or not there is excess slowing – that is, how much is too much? This is a somewhat subjective call. Major determinants include age and state, and the reader must constantly bear these factors in mind. Look for pages in which the patient is fully awake. (If the patient is drowsy throughout, this may not be possible.) Most electroencephalographers accept a small amount of theta in the background of adults as normal (say up to 5%) – mainly in the temporal regions.

Generally speaking, delta activity does not appear in the normal, waking adult EEG. Perhaps a few random low-voltage delta waves might be acceptable. Note that delta is common in the EEGs of children (see section on children). Also, in the elderly, delta waves are commonly recorded in the temporal derivations, indicative of some degree of cerebral pathology but not necessarily structural disease demonstrable on an imaging study.

Now, describe any consistent focal slowing, theta or delta, that indicates localized cerebral pathology. The focality may be present in a setting of a slow disorganized background, or may stand out against a relatively normal background. Finally, describe any bifrontal delta activity, its symmetry or asymmetry, rhythmicity, and amount.

After determining what the background of the record contains in terms of slowing, evaluate the presence or absence of epileptiform activity. Describe the type and location of any spikes, sharp waves, spike-wave complexes, or other paroxysmal discharges (e.g. episodic sharp theta or delta frequencies, including FIRDA). A statement concerning discharge abundance should be made. Focal discharges such as spikes may be obvious, or hidden in the ongoing background. Reliance on fairly strict definitions of epileptiform discharges is essential. Sometimes, the record seems to contain sharp potentials everywhere! Careful analysis will reveal that most of these putative sharp waves are simply the result of a polyrhythmic background – superimposition of various frequencies.

The alert recording having been assessed, now turn to the recording during drowsiness. In most cases, subjects become drowsy during some part of the record. Look for various drowsy patterns that are found in normal adult subjects. These include, but are not limited to, slowing of the PDR, interruption of the PDR by slower activities, anterior spread of a slowed PDR, generalized reduction in amplitude, appearance or increase in diffuse theta activity, bifrontal delta
activity in older subjects, and generalized rhythmic 4 to 5 Hz activity in children.
Note that subjects may drift in and out of drowsiness rapidly. This cannot be
determined by clinical observation. Also look for roving eye movements in the
anterior derivations; this is a good sign of drowsiness. There are relatively low-
voltage slow potentials, maximal in the frontal regions. Vertex sharp waves may
be seen during drowsiness and do not define entry into Stage II sleep. In addi-
tion, early sleep spindles may appear, usually less than 1 second in duration.
POSTS and K-complexes may also appear without full development. These
features, however, herald the approach of Stage II sleep.

**Important concept:** Recording of drowsiness is an essential element in EEG
diagnosis. Often, pathological findings occur mainly, or only, during this state. Of
particular importance is the precipitation, or exaggeration, of epileptiform
activity (spikes, spike-wave complexes – also sharp waves if a broad definition is
accepted). Slow wave abnormalities are frequently exaggerated during drowsi-
ness. Bifrontal rhythmic delta (FIRDA) may become more prominent during
this state. In any case, indicate the effect of drowsiness on the major findings.

After drowsiness, move to the main phenomena of sleep. Describe the features
of Stage II sleep (established sleep spindles, vertex sharp waves, K-complexes,
POSTS, and increased diffuse slowing in theta and delta ranges). At first, theta
predominates, followed by increasing amounts of delta. Note that vertex sharp
waves are not always sharp. On the other hand, they may be very sharp, and
resemble spike potentials. In addition, they may be isolated and sporadic, or
highly rhythmic.

Stage II sleep is followed by SWS. During this state the background is dom-
inated by delta activity. At the same time, sleep spindles become less prominent
and may disappear. In general, SWS is infrequently recorded in adults during
routine EEG recording. On the other hand, SWS occurs frequently in young
children, especially after they have been sedated. Include in your description the
effect of sleep on any abnormalities previously noted – or new abnormalities that
may appear.

You are now ready to dictate your report. Bear in mind always that you are
trying to convey what patterns you have seen, what they mean, and how you can
assist the clinician.