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2012
Collaborate
to Innovate

Electronic patient-reported outcomes (ePRO):

Equivalent to paper?
Or better and more versatile?

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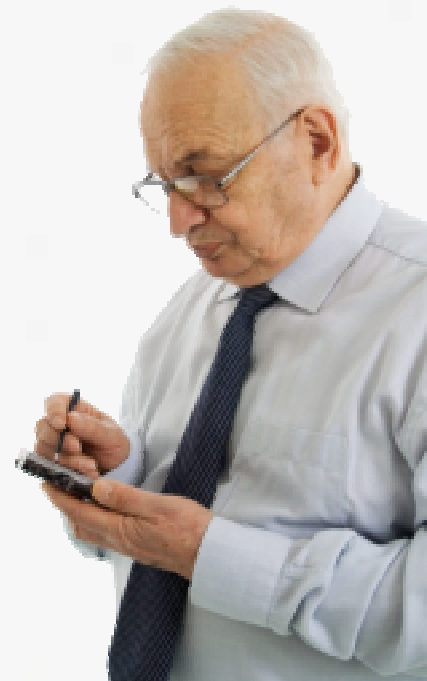
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Electronic Patient-reported Outcomes (ePRO):

- Data collected directly from the patient using diaries or questionnaires
- Electronic methods help both patient and researchers
 - Time stamping and time windows
 - Alarms and reminders
 - Automatic validation and navigation
- Variety of input methods
 - Dedicated handheld devices
 - IVR/Telephone
 - Internet/web-based



ePRO : When do we need to show equivalence to paper?

- Instrument migrated from validated paper form to ePRO
- Need to use data from paper and electronic modes interchangeably



ePRO : When do we need to show equivalence to paper?

- Instrument migrated from validated paper form to ePRO
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If neither of these apply, you do not need to show equivalence:

Paper is not the Gold Standard!



Differences between electronic and paper

- There are always **some** differences, even if appearances are closely matched, e.g.
 - Tapping rather than ticking or circling a choice
 - Action to modify a choice
 - Navigation
- The possible effects of these differences must be evaluated



Evidence for equivalence

- Generic : studies showing whether particular types of change are likely to affect scores
 - Meta-analysis of electronic/paper comparisons
 - Studies directed at impact of specific changes.
- Qualitative : interviews with patients to investigate how they use and understand the instrument
- Quantitative : Formal comparisons using methods similar to the for test-retest reliability
 - Crossover within-patients design
 - Evaluate mode differences and correlations



What evidence is needed?

Level	Type of change	Action
Minor	No change in context or meaning	Cognitive debriefing
	Justified by existing literature	
Moderate	Changes in layout or wording that could affect interpretation	Equivalence testing
Substantial	Changes that clearly affect context or meaning	Psychometric Validation



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Equivalence – the most common scenario

- Changes evaluated, and shown to be within the range where equivalence can be supported by existing evidence
- Qualitative interviews in target patient group to confirm that they interpret the items and response options in the intended way.



Impact of mode differences

- Response bias
 - Responses to a question could be affected by layout, visibility, size.
 - One mode is not necessarily right
- Usability/Acceptability
 - May affect willingness to take part, and so introduce sampling bias
 - Paper needs to be evaluated, not just electronic modes!



Response bias : an example

- Primacy effect
 - Options earlier in list tend to be more likely to be responded to
 - Depends on cognitive load and motivation
 - Common to all modes of presentation
- Visibility effect
 - Options initially visible more likely to be responded to than items shown after user action
 - Specific to electronic modes of administration

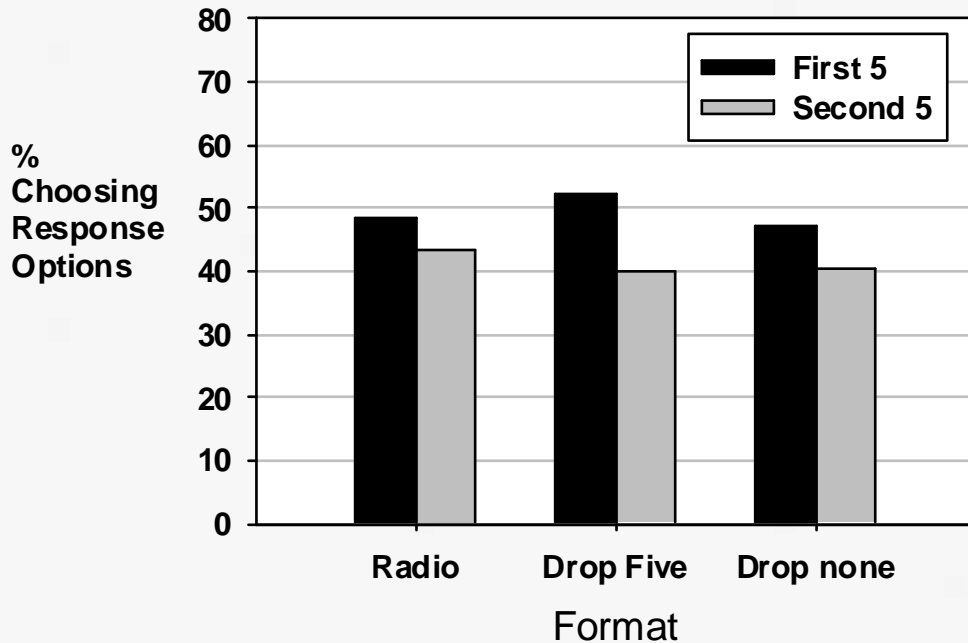


Visibility effect web study

- Three response options
 - Radio buttons (all options visible)
 - Drop-down (First 5/10 initially visible)
 - Drop-down (No options initially visible)
- Questions on features of cars
- Between subjects comparison
 - Balanced rotated order of options
 - N = 2722



Web study results



Web study results

- Small primacy effect
- Larger visibility effect
- Results support design principle of making all response options immediately visible to respondent



Differences that do not materially affect responses

- Single versus multiple questions per screen/page
- Vertical versus horizontal response layout
- Changes in size of graphic scale (within limits)

These are all changes commonly made when migrating from paper to device



Using electronic features to improve PROs

- Compliance aids, such as alarms and reminders
 - Particularly important for event-based diaries
- Navigation aids, such as automatic branching and skipping
 - Prevention of inconsistent results, such as ratings for events that did not occur
- Increased privacy
 - Especially useful for sensitive topics



Documenting data quality

- Comparison of recorded event rates between modes
 - Lower rates may indicate missed events
- Comparison of internal consistency (e.g. Cronbach's α) and reliability (e.g. ICC) between modes
 - Better recording may lead to lower error variance
- Comparison of the frequency of impossible or improbable data
 - ePRO applications often prevent illogical or inconsistent entries

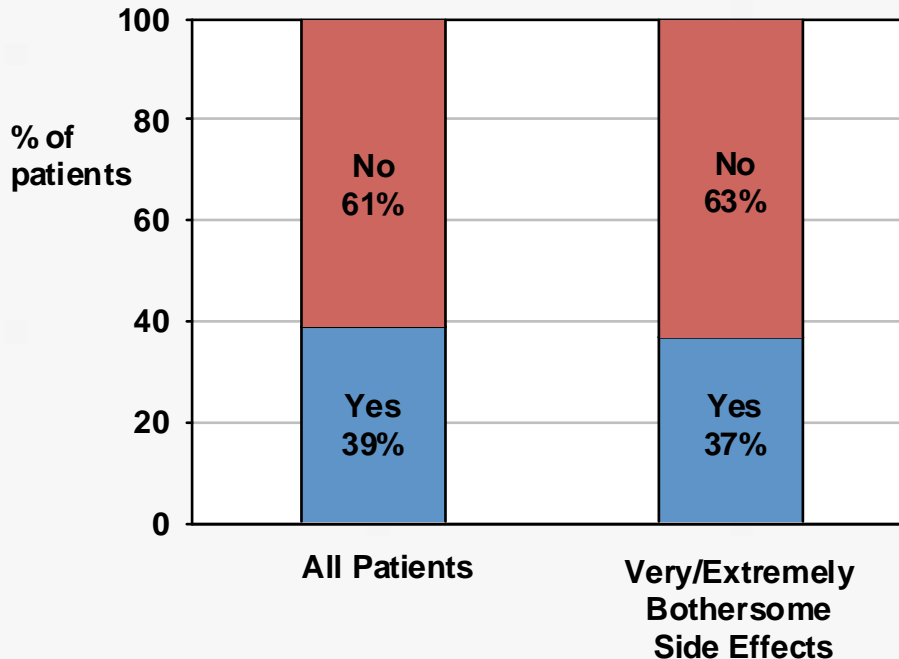


Improving adverse event monitoring

- iGuard.org is established monitoring site
- Patients enrolled in online survey
- Survey is similar to PRO instruments
- Results published on several CNS medications including SSRIs
- Only about 40% of adverse events were reported to patient's doctor
 - Proportion not reported independent of severity/bothersomeness



Adverse events reported to patient's physician



Improving event reporting

- Adverse events are only one type of event collected using ePRO
- Clinical events often collected with diaries, e.g.:
 - Micturition
 - Bowel movements
 - Seizures
 - Migraine attacks
- Improved data collection methodology can lead to both increased reported frequency and reduced error variance for these measures



Improving consistency of reporting

- Study on insomnia diary using handheld device compared to paper
- Data quality primary outcome measure
- Question “Did you fall asleep last night?”
- If No:
 - 50.7% of paper diaries had responses for question “Describe your sleep last night”
 - Electronic diary did not permit inconsistent entries



Improving accuracy of reporting

- “Data hoarding” (filling in large amounts of paper data retrospectively) may lead to suspicious levels of data consistency
 - Many similar entries
 - People are not good random number generators!
 - Very high apparent compliance rates
- Electronic methods give time control and recording
 - Time windows limit entries to pre-defined range
 - Time-stamping documents when entries are made



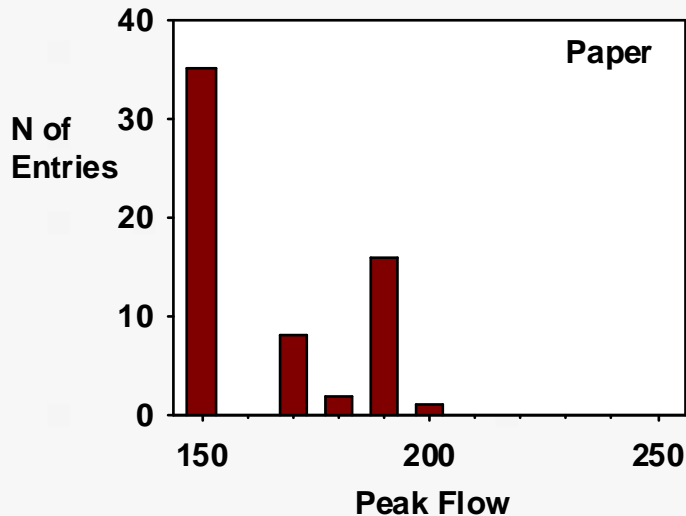
Improving accuracy of reporting

- Study carried out in 37 patients with asthma, who used paper or handheld diaries for one month
- Higher recorded compliance with paper (99.8%) than with electronic (91%)
- Evidence from several patients suggesting high paper compliance is spurious



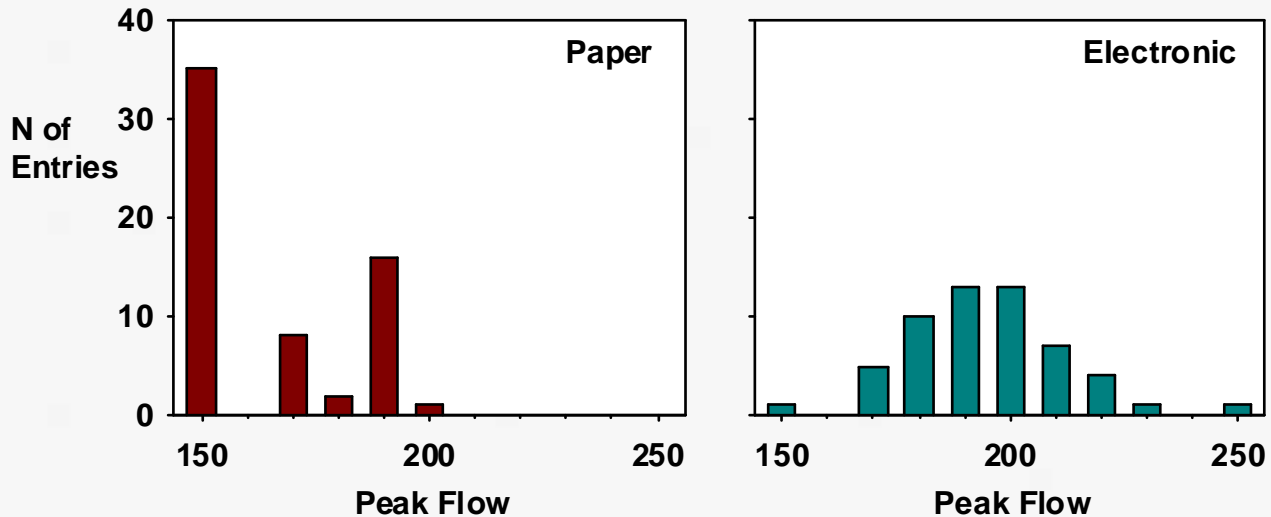
Improving accuracy of reporting

Peak flow data from one patient :



Improving accuracy of reporting

Peak flow data from one patient :



Improving accuracy of reporting

- Several patients showed patterns indicating improbable entry of a small number of values
- In electronic mode compliance was good and pattern as expected for these patients
- Use of electronic device clearly aided patient compliance and improved accuracy



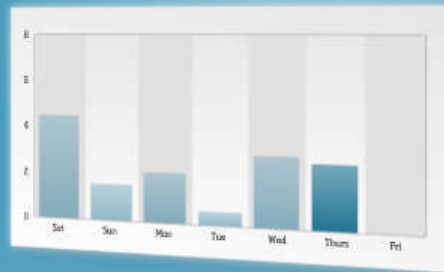
Moving ePRO onto the web

- Use of existing equipment for web data collection gives maximum accessibility
- Can use established networking sites
 - Many existing health resources look and feel like ePRO
 - May have very large data resources
- Personalised feedback based on user's own history, and comparison with others



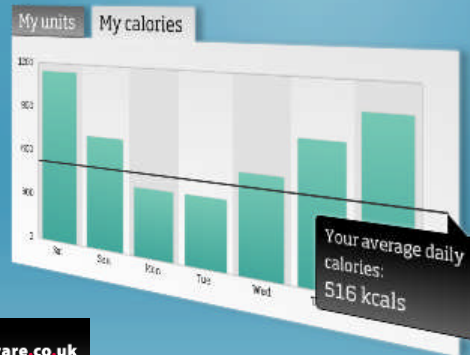
Track your drinking over time

Find out how many units are in your favourite drinks. Add them to your diary and see the running total.



Get personal feedback

See how the units and calories are adding up over days and weeks.



 **MyDrinkaware** for the facts drinkaware.co.uk

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Exercise Monitoring



Track Progress

Update your progress through web, email, or phone.



See Results

Get feedback about your progress and learn what influences your behavior.



Get Encouraged


Receive encouragement from your friends or others with the same

goal!

TrackVille



How open should you be on the web?

Model		Recruitment	Equipment
Closed (conservative)		Through clinic/study site, identifiable patients with medical records	Supplied by sponsor
		Through web, patient identity known	Vetted by sponsor, e.g. screen size, type of input
Open (innovative)		Through web, anonymous patients	Whatever the patient uses



Which device is being used?

- Web access is possible from an enormous variety of devices with very different screen sizes



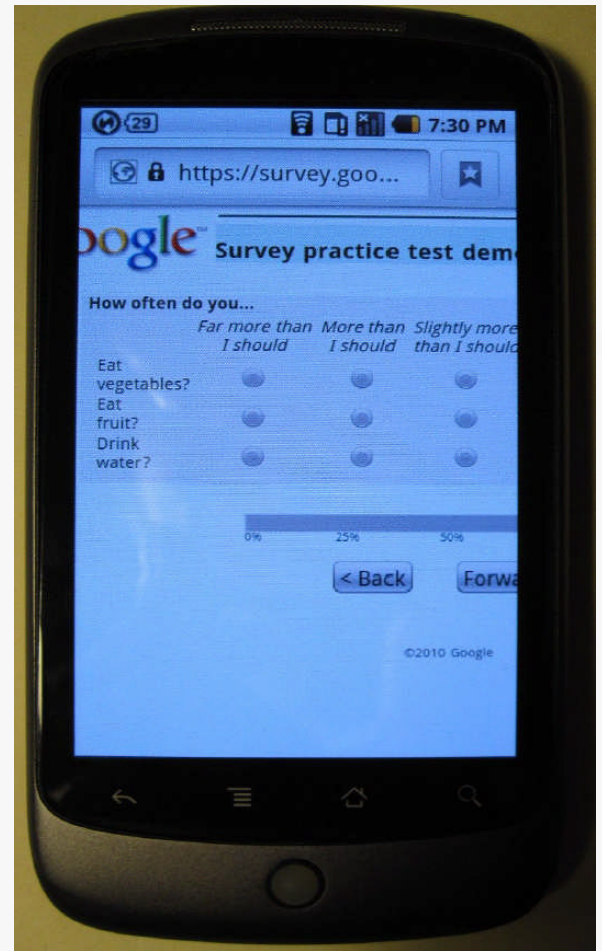
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Changing the approach to development and testing for the web

- Keep the visible interface as simple as possible
 - That doesn't mean the application must be simple
 - Hiding complexity from the patient has always been a good idea
- Set a minimum supported size, and check it
 - And test your checks in the main device/browser combinations
- Test user interface over a range of sizes and conditions
 - If a visual analogue scale works OK at 2, 4 and 10 cm long, it will work at 3 or 7cm...



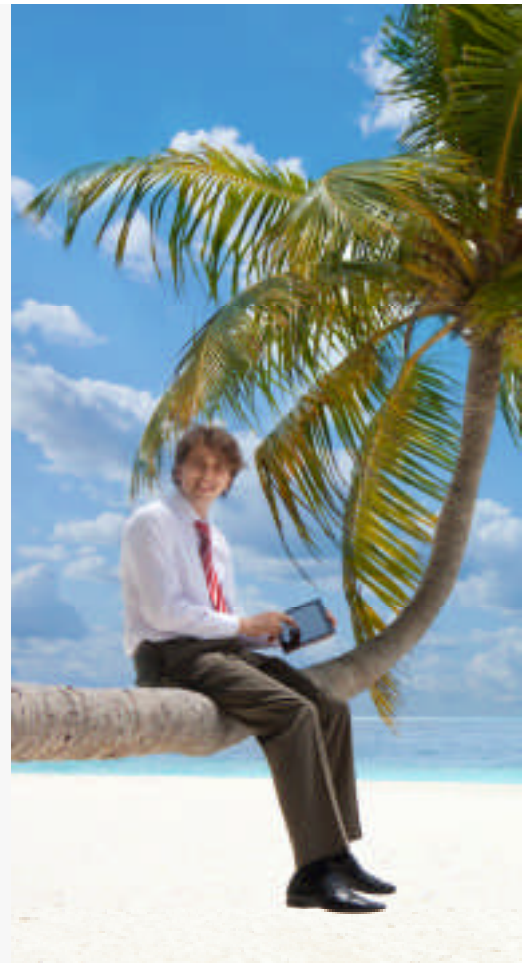
Conclusions

- ePRO may be equivalent to paper, or better
- Broadly-based approach to determining equivalence and quality is needed
- The web can be used to implement ePRO with little change in the underlying model, but offers scope for important new uses.



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