THE MINI MILESTONES ASSESSMENT

THE MINI MILESTONES ASSESSMENT (MINI-MAS), A DIRECT OBSERVATIONAL TOOL TO ASSESS CLINICAL MILESTONES IN THE ERA OF COMPETENCY-BASED EDUCATION

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TITLE-The Mini Milestones Assessment (Mini-MAS), a direct observational tool to assess clinical milestones in the era of competency-based education.

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Abstract

Background: Competency based medical education will move training programs away from a time based standard to a model of competence and milestones. Assessment, observation and feedback are key ingredients to successful implementation. Work based assessment tools will be an important part of a multi-modal programmatic assessment for learners.

Purpose: The purpose of the study was: 1) to facilitate the development and implement a pilot competency-based curriculum into the general pediatric component of the PGY 1 year at McMaster University, pediatric residency program, 2) to develop a tool, the Mini Milestones Assessment (Mini-MAS) to assess six medical competencies and progression through milestones using the Dreyfus Developmental Model and to pilot the tool in the general pediatric rotations for the PGY 1 and 4 residents and 3) to test the reliability, validity, acceptability and feasibility of the Mini-MAS tool.

Method: Twelve PGY 1 residents at McMaster Children's Hospital were required to complete 40 observations (10 history taking, 10 physical exam, 5 clinical reasoning, 5 communication with families, 5 communication with staff and 5 collaboration) during their general pediatric component of the 2013-2014 academic year. These same competencies were also observed for 9 PGY 4 residents over the same competencies over the same time period although this group was required to complete only 15-20 encounters. Following the study period, a survey was administered to the residents and faculty to assess acceptability and feasibility of the Mini-MAS tool. Kane's validity framework,

which is divided into four components (scoring, generalization, extrapolation and decision), was used to evaluate the Mini-MAS tool.

Results: PGY 1 and PGY 4 residents had an average of 36 and 16 observations completed, respectively, across a wide variety of settings and clinical problems with multiple assessors. The scale of the Mini-MAS tool was used appropriately. The tool was able to differentiate between the PGY 1 and PGY 4 learners and showed progress of the PGY 1 learners through the academic year. The G coefficient overall for the Mini-MAS tool was 0.8 for the PGY1 residents and 0.5 for the PGY 4 residents. Correlation between the six competencies assessed was low, achieved by only one competency being observed and having grounded anchors. Learners and faculty were satisfied with the tool. The tool allowed learners to be observed more frequently and receive timely valuable feedback.

Conclusion: A pilot competency based curriculum for PGY 1 residents was successfully implemented. The Mini-MAS tool added, as a formative assessment mode to a multi-modal assessment program will benefit the trainee, by increasing their observations and providing residents with valuable feedback. The assessment will inform residents where they stand with respect to their level of training, what competencies they can improve on and how they can make such improvements.

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List of Abbreviations

Mini-MAS: Mini Milestones Assessment

ACGME: Accreditation Council for Graduate Medical Education

RCPSC: Royal College of Physicians and Surgeons of Canada

OBE: Outcomes-Based Education

CBE: Competency-Based Education

CBME: Competency-Based Medical Education

WBA: Work Based Assessment

OSCE: Objective Structured Clinical Exam

ITER: In-Training Evaluation Report

Mini-CEX: Mini-Clinical Evaluation Exercise

STACER: Structured Assessment of Clinical Encounter Report

CEX: Clinical Evaluation Exercise

ITE: In-Training Exam

MCQ: Multiple-Choice Questions

PGY: Post Graduate Year

ACAT: Acute Care Assessment Tool

CBD: Case Based Discussion

CTU: Clinical Teaching Unit

LCC: Longitudinal CanMEDS Competencies

NRP: Neonatal Resuscitation Program

PALS: Pediatric Advanced Life Support

CPSO: College of Physicians and Surgeons of Ontario

CPS: Canadian Pediatric Society

MCQ: Multiple Choice Questions

SAQ: Short Answer Questions

ABP: American Board of Pediatrics

MSF: Multi-Source Feedback

SRC: Senior Resident Clinic

Coll: Collaborator

ComF: Communication with Families

Com HCP: Communication with health care professionals

ClinRe: Clinical Reasoning

Hist: History taking

PE: Physical Examination skills

SPSS: Statistics Package for Social Sciences

VC: Variance Component

Declaration of Academic Achievement

The following is a declaration that the content of the research in this document has been completed by Moyez Ladhani and recognizes the contributions of Dr. Kelly Dore, Dr. Meghan McConnell and Dr. Karen McAssey in both the research process and the completion of the thesis. Moyez Ladhani contributed to the study design and was responsible for data collection, data analysis and writing of the manuscript. Dr. Kelly Dore assisted with the study design, data analysis and manuscript review. Dr. Meghan McConnell and Dr. Karen McAssey provided insightful advice and manuscript review.

Chapter 1: Background and Literature Review

Competency-Based Education

Background.

Television portrays fictional doctors with variable qualities. Some are well rounded and wholesome; others, such as Dr. Gregory House of the medical drama *House*, lack sympathy, are narcissistic and have poor communication and collaboration skills. However, while Dr. House lacks the empathy we expect from the role of a physician, he is an astute clinician with superior diagnostic skills. Although this is a fictional TV character, many of us can think of physicians with similar qualities. Both the public and accreditation boards have initiated a culture shift where overlooking bad behavior because a physician has strong medical expert skills is unacceptable. Consequently, many governing bodies are promoting the development of outcome or competency-based frameworks that focus not only on the development of medical expertise, but also promote the development of intrinsic qualities, such as professionalism and communication. For example, the Scottish Doctor, the Accreditation Council for Graduate Medical Education (ACGME) Next Accreditation System, and CanMEDS 2005 are but a few frameworks that have been developed to identify the multitude of skills required by a doctor (Scottish Dean's Medical Curriculum Group, 2007; Nasca, Philibert, Brigham, & Flynn, 2012; Frank, 2005).

The need for more integration of skills is one of the reasons the competency-based education movement has taken off over the past decade. Not only has the number of publications on competency-based education exploded, the widespread use of the CanMEDS competencies indicates its acceptance by the medical community (Frank & Danoff, 2007). Organizations such as the Accreditation Council for Graduate Medical Education (ACGME) and the Royal College of Physicians and Surgeons of Canada (RCPSC) are preparing to make competency-based education an accreditation standard (Nasca et al., 2012; Frank, Snell et al., 2010; Frank, Snell, & Sherbino, 2014). There still remains a lot of questions and much more work including change to policy, practice, assessment and more to be done before competency-based education can be successfully realized and be widely accepted as the new norm.

Advancement in the pedagogical rigor of medical education has been evident since the time of Flexner and has continued into the development of a competency-based model of education (Cox et al., 2006). The concept of an outcome-based approach was first introduced in the mid to late 20th century. Tyler (1949) advised educators to apply four basic principles to the development of any curricular project, with the key principle being the presence of appropriate learning objectives. Several years later, Bloom (1956) developed a taxonomy that classified educational goals into knowledge, skills and attitudes. Building on the work of Tyler and Bloom, Mager (1975) developed the concept of instructional objectives and argued that these objectives should be expressed in measurable terms. Mager's model is one of the

first to emphasize student achievement over teacher activity, with these achievements being described in behavioral, observable terms amenable to assessment.

The 1990s observed a "second coming of competencies" (Albanese, Mejicano, Mullan, Kokotailo & Gruppen, 2008, p. 249). During this time, Harden, Crosby and Davis (1999) argued that:

> Outcome-based education, a performance-based approach at the cutting edge of curriculum development, offers a powerful and appealing way of reforming and managing medical education. The emphasis is on the product, what sort of doctor will be produced rather than on the educational process. In outcome-based education the educational outcomes are clearly and unambiguously specified (p.7).

So began the debate over this anticipated paradigm shift, perhaps exacerbated by the perceived lack of clarity around terminology. It is worthwhile to note that confusion still remains in the literature regarding how best to define competency-based education. For example, Harden (2002) notes that the terms learning outcomes and instructional objectives often are used interchangeably; he argues however, there are five key differences between these terms:

1. The detail of specification;
2. The level of specification where the emphasis is placed;
3. The classifications adopted and interrelationships;

4. The intent or observable result;

5. The ownership of the outcomes.

Clarifying the difference between learning outcomes and instructional objectives is important as it enables educators to effectively develop and implement competency-based education curricula.

"Outcome-based" and "competency-based" education (OBE and CBE respectively) are also used interchangeably within medical education settings. Albanese et al. (2008) defines the distinction between these two concepts as "what we want and what we need in our doctors" (p.251). The difference between the two is negligible. A recent review found essentially no difference between the two terminologies (Morcke, Dornan & Eika, 2012) and these terms will be used interchangeably in the present thesis.

A recent review on the definitions of competency-based education identified 173 definitions (Frank et al., 2010), and within these definitions, the authors identified 4 major themes and 6 sub-themes as shown in Table 1:

Table 1: Competency-Based Education (CBE) definition themes

Major Themes:	Organizational Framework Rationale Contract with time Implementing CBE
Sub-Themes:	Outcomes defined Curriculum of competence Demonstrable Assessment Lerner-centered Societal needs

From this research, Frank and colleagues attempted to develop an all-inclusive definition of competency-based education:

> Competency-based education is an approach to preparing physicians for practice that is fundamentally oriented to graduate outcome abilities and organized around competencies derived from an analysis of societal and patient needs. It deemphasizes time-based training and promises greater accountability, flexibility, and learner centeredness (p. 636).

While their review is thorough, only time will tell if this proposed definition will be widely adopted. The authors have made an effort to incorporate the major and sub-

themes in their definition of CBE. However, as the definition incorporates the inclusion of societal and patient needs, defined competencies should frequently be reviewed to ensure relevance (Lurie, Mooney, & Lyness, 2011).

Within their review, Frank et al. (2010) argue for a move to competency-based education. The current model of education is a time-based model. Hodges (2010) describes this as the 'tea-steeping model', whereby medical educators "…put the student (tea) in medical school (hot water) for a fixed period of time and, voila! After a historically determined interval of time, we assume a competent practitioner, like a good cup of tea, will result" (p. S37).

Despite there being no evidence between length of training and competence, the time-based, "tea steeping" model has been embodied in every medical school for decades (Hodges, 2010). There is societal and government pressure to justify the current historical length of training (Naik, Wong, & Hamstra, 2012). Since educators agree that learners acquire knowledge, skills and attitude at different rates, competency-based education makes theoretical sense (Naik et al., 2012). We should be progressing learners as they become proficient in milestones at critical stages, rather than a time-based approach (Iobst et al., 2010). CanMEDS 2015 defines a milestone as "the expected ability of a health professional at a stage of expertise" (Frank, Snell & Sherbino, 2014, p9).

Proponents maintain that competency-based education will allow learners to integrate competencies demanded by their role to develop a holistic physician (Swing,

2010). Though an individualized plan for each learner is attractive, the time and cost could become a rate-limiting step given the continuous feedback and assessment that will be required (Hodges, 2010). Brooks (2009) argues that assessing competencies will require a detailed checklist in order to remove subjectivity, and we will produce physicians with a large repertoire of skills, who will not be able to apply and integrate those skills. However, having explicit learning outcomes will require learners to integrate these skills in order to achieve a competent well-rounded practitioner. Competencies are complex cognitive skills requiring the learner to build on simpler ones (Swing, 2010). The iterative nature of competency based medical education (CBME) highlights learner progression as they build on existing knowledge and skills. Some have argued that learners may just achieve the minimum standard and caution that this could lead to demotivation if competency-based education is not carefully applied and monitored (Leung, 2002). Alternatively, well-defined competencies may enhance engagement, self-directed learning and motivation.

We must move on from relying the current model with much of the learning occurring in an apprenticeship style of training. Potential barriers to implementing competency-based education will include the development of the competencies, the process of assessment, faculty development and student and faculty buy in.

Implementing Competency-Based Education:

Moving from a time-based model to a competency-based model will be a slow and daunting task. Medical organizations will need to collaborate to develop easily

adaptable competencies, as well as guidance with the development of assessment tools and tips for faculty development. Guidebooks and "train the trainer" workshops, similar to those used in the implementation of the CanMEDS 2005 framework, will be helpful (Frank & Danoff, 2007).

Harden (2007) has described three patterns of behavior for those who engage in the process of development of competency based education: the ostrich, the peacock and the beaver.

> The ostriches believe that learning outcomes are a passing fad and see no merit in an outcome-based approach to education. Peacocks on the other hand work hard to develop a set of learning outcomes and having done so ostentatiously display them. Lastly, the beavers not only develop a set of learning outcomes…. but have worked hard to implement OBE (Harden, 2007, p. 667).

Harden has published an outcome-based educational inventory to help the "beaver" implement the new curriculum. This inventory consists of nine dimensions:

1. Statement of learning outcome: there should be a clear, documented statement of progression and outcomes.
2. Communication with staff and students: staff and students should be aware and familiar with the existence of each outcome statement.
3. Educational strategies: activities should be targeted at achieving the learning outcomes.

4. Learning opportunities: learning opportunities should be selected to match the learning outcomes.

5. Course content: the learning outcomes will determine the curriculum content.

6. Student progression: student's progress should be measured and monitored using the learning outcomes.

7. Assessment: a multimodal assessment program is required for learners to demonstrate they have achieved the required outcomes.

8. Educational environment: supportive environments should be developed to allow for the achievement of the outcomes stated. The learner should be part of the system they are learning about.

9. Student selection: learners should be selected at the required level of competence and suitable for an outcome-based approach.

The use of this tool can help guide schools and teachers with the implementation of competency-based education and can also help monitor its progress. Several researchers have already developed milestones that can also be used as a starting point (Green et al., 2009; Hicks et al., 2010; Frank, Snell & Sherbino, 2014).

In 2009, The University of Toronto orthopedic residency program began a pilot project using a competency-based framework with milestones rather than time on a service. The program curriculum covered technical skills as well as the intrinsic CanMEDS competencies. Residents in the new curriculum reported a high level of satisfaction; they were more confident in their skills and showed better skill development than residents in the traditional stream (Alman, Ferguson, Kraemer, Nousiainen, & Reznick, 2013). While the number of residents is small, the results look promising. Notably however, the reports demonstrated no evidence of evaluation of non-technical skills. Instead, the curriculum focused extensively on the use of simulation to evaluate the technical skills. It may be easier to implement competency-based education in the surgical specialties with a focus on technical skills if they are easier to measure. To convince the "ostriches" we will need to show improvement in more than just technical skills. Issues that arose when implementing the pilot included logistics and increased demand on faculty time (Alman et al., 2013).

Assessment

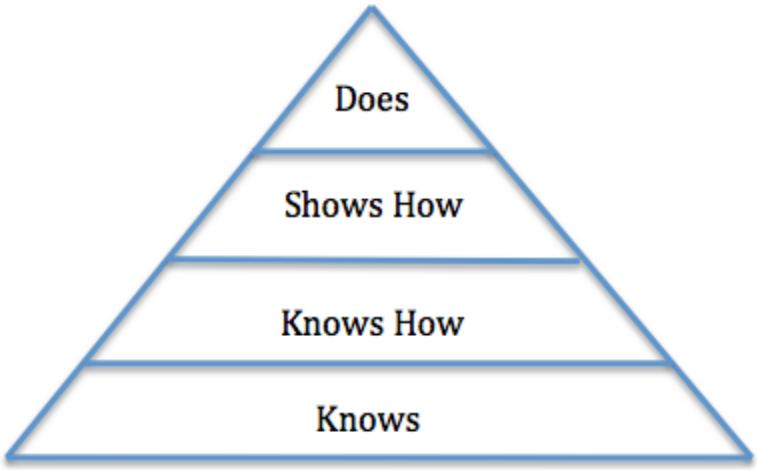
Learners' advancement within competency-based education frameworks will rely on frequent and effective assessment methods. Much work remains to be done to determine how educators will measure the defined competencies (Hodges, 2010). Intrinsic skills such as communication and collaboration remain difficult to measure and yet are integral components of the desired competencies and ensuring the graduating physician is not just a medical expert. The learner's ability to move through the CBME curriculum will rely on effective and psychometrically sound

assessment methods. Competency-based education will require both formative and summative assessment (Carraccio, Wolfsthal, Englander, Ferentz, & Martin, 2002). Effective coaching, mentoring and feedback will be required to incorporate the concept of deliberate practice, which is an essential skill to develop in medical trainees (Holmboe, Sherbino, Long, Swing, & Frank, 2010). Eva and Regehr (2008) note the learner can use the feedback for meaningful self-assessment that is crucial in competency-based education. Frequent observation will be required of the learners, which may potentially overwhelm faculty resources. Though a move to simulation will occur, frequent work-based assessment will remain key in order to observe the learner in the context of their work i.e. observe as they do their clinical work in clinical settings (Holmboe et al., 2010).

Work Based Assessments (WBAs)

Knowledge, skills and attitudes should be assessed using a multi-faceted longitudinal approach (Sherbino & Frank, 2011). The use of a multi-modal assessment strategy can overcome the limitations of any one-assessment format. Longitudinal assessment monitors ongoing development and avoids excessive testing at any one point (Cox, Irby, & Epstein, 2007). Miller (1990) suggests the achievement of competence progresses from “knows” to “knows how” to “shows how” to “does” (see Figure 1).

Figure 1: Miller's Pyramid



Objective measures such as written examinations (e.g., multiple choice exams, the American Board of Pediatrics in training exam and short answer questions) and the objective structured clinical exam (OSCE) measures the "knows" and "knows how" levels of Miller's pyramid. These tools are well researched and a good measure of knowledge. However, we must graduate holistic physicians who are competent in all aspects of medicine, not just clinical knowledge. We owe this to our programs, but more importantly to our patients. Assessment of trainees with higher levels of expertise is challenging; for example, experts often perform poorly in artificial testing environments but make competent judgments in real-world clinical scenarios (Cox et al., 2007). As such, work based assessments are an important part of the multi-modal assessment of any program and assess the "does" part of Miller's pyramid. Kogan

and Holmboe (2013) define WBAs as "…the assessment of trainees and physicians across the continuum of day-to-day competencies and practice in authentic, clinical environments…It enables the evaluation of performance in context" (p. S68). Observation is essential to provide meaningful formative and summative feedback (Turnbull, Gray, & MacFadyen, 1998). A recent systematic review identified 55 unique tools for direct observation and assessment of clinical skills of medical trainees (Kogan, Holmboe & Hauer, 2009). Of these tools, the pediatric residency program at McMaster University uses three common methods of direct observation: 1) the day-to-day informal assessment resulting in a formal end of rotation in-training evaluation report (ITER), 2) the observed long case (observed history and physical) in a clinical setting that occurs twice a year and 3) a monthly mini-clinical evaluation exercise (mini-CEX).

The In-Training Evaluation Report (ITER).

The ITER is a tool commonly used to evaluate knowledge, acquisition and development of skills and performance behaviors (Turnbull et al., 1998). Teachers complete the ITER after a block of training has occurred. Though programs rely on this tool, research has shown poor inter- and intra-rater reliability, and suggests that the tool does not discriminate between residents (Gray, 1996; Holmboe & Hawkins, 1998). Faculty act as both teacher and evaluator and often lack training for the dual role. Though the observations occur daily, the ITER is completed retrospectively, thus relying on faculty to accurately recall details of past performances (Turnbull et al., 1998). Furthermore, faculty who have not directly observed the learner often

complete the forms (Epstein, 2007), which is problematic as such individuals are assessing learners based on information not obtained from direct observation. Assessor specificity and halo effect are common problems. Within the context of medical education, halo effects refer to the tendency to rate someone highly on particular attributes that are not necessarily related to clinical skills. For example, a resident who communicates well, collaborates effectively and is generally "nice" often does well on the ITER, but this may not reflect his or her true abilities (Wilkinson & Wade, 2007). Having the ITER completed by only one supervisor further adds to limited attributes and perspectives being assessed (Wilkinson & Wade, 2007). One rater also leads to "leniency/severity" (e.g., doves/hawks) error (Gray, 1996). Raters also fail to use the entire rating scale effectively often right shifting assessments (Gray, 1996). Despite these limitations the ITER continues to be the mainstay of assessment, but the need for additional tools is clear.

Structured Assessment of Clinical Encounter Report (STACER)

When the Royal College of Physicians and Surgeons of Canada stopped administering an oral exam as the licensing exam in pediatrics instead moving to an Objective Structured Clinical Exam (OSCE) format, the College asked individual programs to administer the Structured Assessment of Clinical Encounter Report (STACER) to assess the clinical competence of candidates. The STACER also known as the "long case" or the clinical evaluation exercise (CEX) consists of an observed history and a physical exam. Afterwards the learner provides a summary of the clinical encounter and problem list. As a result programs have established "practice"

STACERs as a formative tool. Though it allows for direct observation, educators cannot rely solely on the STACER/CEX. The practice STACER takes about 90 minutes, where one faculty observes a resident on one non standardized clinical encounter. That alone makes it case and examiner specific and faculty members vary in stringency. As such, the results of the STACER are not generalizable beyond the observed encounter (Norcini, Blank, Duffy, & Fortna, 2003), as a single observation does not allow for reliability due to content specificity (Holmboe & Hawkins, 1998). The STACER is also not representative of the residents' day-to-day activity (Hawkins, Margolis, Durning, & Norcini, 2010). Kroboth et al. (1992) concluded that 6-10 evaluations are required to reach a reliability coefficient of 0.8. That number of evaluations would require substantial time commitment resulting in poor levels of acceptability from faculty. Furthermore, the STACER does not allow for learners to be assessed in the context of their day-to-day work (Crossley, Johnson, Booth, & Wade, 2011). For this reason the program also incorporates a monthly mini-clinical evaluation exercise (mini-CEX).

Mini-Clinical Evaluation Exercise (mini-CEX)

The mini-CEX is the most studied direct observation tool and has been adapted in various areas of practice (Kogan et al., 2009). During the mini-CEX, a faculty member observes a resident during a 15-20 minute patient encounter. The mini-CEX can be easily integrated into daily clinical activities (Hawkins et al., 2010) and can be done several times a year by different faculty across various clinical settings and patient problems (Norcini et al., 2003). Performance on the mini-CEX is assessed

using a 9-point scale that evaluates residents' competence in interviewing, physical examination, professionalism, clinical judgment, counseling, organization and overall competence, although not all areas have to be assessed for every evaluation. In addition faculty provide feedback at the end of the observation period.

A variety of studies have shown that the mini-CEX allows for better feedback and produces reliable and valid scores across a broad range of situations. For example, Norcini et al. (2003) collected a years worth of mini-CEX data across 21 training programs. The median time the examiner spent observing the resident was 15 minutes and 5 minutes for feedback. A total of 1228 encounters were observed, allowing for the assessment of a broad range of problems clinical skills. The residents' scores showed growth in all areas during the year and were statistically significant providing construct validity for this study. The multiple encounters with different examiners and patients increased the reliability of the mini-CEX ratings. Ten or more ratings produced a tight confidence interval, although increasing the number of ratings beyond that showed only small gains. Another study examined mini-CEX scores of 23 first-year internal medicine residents, who completed an average of seven mini-CEXs totaling 162 forms, completed by 46 different attending physicians (Durning, Cation, Markert & Pangaro, 2002). The internal consistency for the 162 forms, as measured by Cronbach's coefficient alpha, was 0.90. In the absence of a "gold standard" for assessing residents' clinical skills, Durning et al. correlated the mini-CEX with the American Board of Internal Medicine in-training exam (ITE), a generally accepted and valid instrument used to test clinical knowledge. The overall

clinical competence and clinical judgment in the mini-CEX correlated significantly with the ITE. Furthermore Durning et al (2002) reported a high completion rate of 96%, providing evidence of the feasibility of the mini-CEX.

Other areas of medicine, as well as undergraduate training have also incorporated the mini-CEX assessment method. Alves de Lima et al. (2007) monitored 108 residents from 17 cardiology residency programs and found that the mini-CEX was able to discriminate significantly between residents in different levels of training, providing evidence of construct validity. Satisfaction of the tool was high for both residents and faculty with a mean of 8.08 and 8.06 out of 9, respectively. However, this study showed problems associated with feasibility of the tool, as only 14.8% of residents were evaluated four or more times. The authors suggested this was due to poor faculty development as only a written guide was provided. Moving to the undergraduate arena, Wang et al. (2011) studied 196 clerkship students in their psychiatry rotation. Three assessment tools were used: the mini-CEX, a standardized patient interview and a multiple-choice question examination (MCQ). The medical interviewing, physical examination, humanistic qualities and counseling domain of the mini-CEX did not statistically correlate with the MCQ. There was a weak but statistically significant correlation between clinical judgment on the mini-CEX and the MCQ. These data suggest that the two tests measure different components of competency thus adding evidence to support the need for multiple modes of assessment.

Hatala and colleague (2006) examined the predictive validity of the mini-CEX when they studied 22 Post Graduate Year (PGY) 4 residents in the 6 months preceding their certifying examination. The authors reported a correlation of 0.73 between the participants' overall clinical competence across the mini-CEX encounters and their final score on their certifying exam, providing further evidence of validity of the tool. In a qualitative analysis, Malhotra, Hatala and Courneya (2008) looked at resident perceptions of the mini-CEX and found that while residents initially perceived the assessment tool as anxiety provoking, they began to see the educational value in the tool especially in receiving formative feedback. The residents appreciated being observed in a real clinical setting and felt the mini-CEX prepared them for their certifying exam. Similarly, Weller, Jones, Merry, Jolly and Saunders (2009) looked qualitatively at resident and faculty perceptions of the mini-CEX. Faculty often felt unprepared or untrained for the assessment, highlighting the need for proper faculty development prior to implementation. However, faculty reported finding the process of giving feedback easier with the mini-CEX. In addition, learners felt they were observed more and received more feedback after the implementation of the mini-CEX.

The mini-CEX has been studied in both undergraduate and postgraduate contexts, across numerous specialties. Many studies have shown its reliability and validity including construct, concurrent and predictive. It allows for more frequent observation and feedback to the learner. After the initial anxiety wanes, the tool is well received by residents. Faculty are satisfied but desire proper faculty development

prior to implementation; this will help with acceptability and feasibility. The data would support the use of the mini-CEX as a formative assessment tool. However, concerns have been raised with the design of the tool as well as what it measures.

Hawkins et al. (2010) evaluated the mini-CEX research from 1995 to 2009 and found scoring for the mini-CEX was similar to other global rating forms. The raters did not use the full nine-point scale. Instead the distribution was shifted towards the higher end of the scale and, the use of the lower end of the scale was infrequent, raising concerns about identifying weaknesses. Additionally, individual competencies tended to be highly correlated. This phenomenon is likely related to the fact the rating form had overlapping descriptors. Though there was progression of scores from junior to senior trainees, the scores alone did not identify specific areas of improvement (Alves de Lima et al., 2007; Hawkins et al., 2010; Norcini et al., 2003). The scale used in the mini-CEX is designed for linear gradations of performance. The scores do not give the evaluators a point of reference to help align a trainee to a category or score (Crossley & Jolly, 2012) causing faculty assessors to resort to norm referencing. Other scales attempt to reflect stages of training (i.e. below expectations, meets expectations etc.), although clinicians report uncertainty about the expectations associated with different stages of training (Crossley et al., 2011). The mini-CEX does provide credible information and can be utilized in the clinical setting, but is it the appropriate tool for assessment of milestones? Competency-based education will require regular evaluation of daily practice to assess all competencies. The

assessment should monitor the learners' progress and identify deficiencies that can be remedied (Driessen & Scheele, 2013).

Designing a Better Tool

Crossley et al. (2011) looked at how to improve assessor agreement and discrimination. They took three work-based assessment (WBA) tools, namely the mini-CEX, the acute care assessment tool (ACAT) and the case-based discussion (CBD) and developed new scales with behaviorally anchored descriptors aligned to constructs of increasing independence and sophistication and thus training levels or milestones. These newly constructed scales were compared with the conventional formats. Using the modified scale, clinicians' were better able to discriminate between high and low performing trainees and showed greater agreement about a trainee's performance. This enhanced agreement across scores reduced the number of assessments required to achieve reliability. For example, the number of assessments required decreased from six to three when using the construct-aligned mini-CEX. Drawing conclusions from this study as well as reviewing the literature on WBA, Crossley and Jolly (2012) have suggested the following recommendations to improve the WBA tool:

1. WBA assessment tools should have anchors linked to the construct of clinical independence, measuring the trainees' level of progression and development
2. Assessors make more reliable judgments of performances they can see clearly in a particular context or activity. However, every context does not provide good information for every competency. The tool should focus on the

competence relevant to the activity, and avoid having multiple competencies to assess at the same time.

The development of effective WBAs requires learners to achieve milestones or benchmarks, which requires experts to help guide learners as they progress from novice to expert, through their training. Clinical reasoning is an important skill learners develop during this progression. Eva (2005) describes clinical reasoning as two processes, the analytic method and the non-analytic method. The analytical method uses hypothetico-deductive reasoning, where learners generate a set of hypothesis, where the non analytical method relies on learner's ability to recall a repertoire of context-specific past experiences (illness scripts) and recognize the relationship to the current problem (Schmidt, Norman, & Boshuizen, 1990). Learners at all stages use both forms of reasoning but experienced learners have the advantage of having more clinical experiences to draw on and thus have a more extensive library of illness scripts to promote pattern recognition (Carraccio, Benson, Nixon, & Derstine, 2008). The Dreyfus model of skill acquisition emphasizes pattern recognition as critical in the developmental progression of the learner to competence (Batalden, Leach, Swing, Dreyfus, & Dreyfus, 2002). The model consists of six developmental stages that document progression from novice to master and has been applied to several forms of adult learning, within the context of the Dreyfus model, Carraccio et al. (2008) describes the six stages for medical training:

Novice:

Is rule driven, uses analytic reasoning and rules to link cause and effect, has little ability to filter or prioritize information, so synthesis is difficult at best and the big picture is elusive.

Advanced beginner:

Is able to sort through rules and information to decide what is relevant on the basis of past experience, uses both analytic reasoning and pattern recognition to solve problems, is able to abstract from concrete and specific information to more general aspects of a problem

Competent:

Emotional buy-in allows the learner to feel an appropriate level of responsibility, more expansive experience tips the balance in clinical reasoning from methodical and analytic to more readily identifiable pattern recognition of common clinical problem presentations, sees the big picture, complex or uncommon problems still require reliance on analytic reasoning.

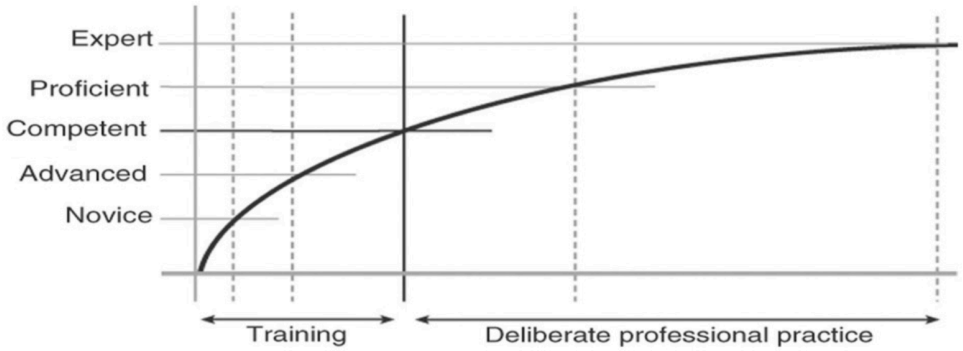
Proficient:

Breadth of past experience allows one to rely on pattern recognition of illness presentation such that clinical problem solving seems intuitive, still needs to fall back to methodical and analytic reasoning for managing problems because exhaustive number of permutations and responses to management have provided less experience in this regard

> than in illness recognition, is comfortable with evolving situations; able to extrapolate from a known situation to an unknown situation (capable), can live with ambiguity.
>
> Expert:
>
> Thought, feeling, and action align into intuitive problem recognition and intuitive situational responses and management, is open to notice the unexpected, is clever, is perceptive in discriminating features that do not fit a recognizable pattern.
>
> Master:
>
> Exercises practical wisdom, goes beyond the big picture and sees a bigger picture of the culture and context of each situation, has a deep level of commitment to the work, has great concern for right and wrong decisions; this fosters emotional engagement, is intensely motivated by emotional engagement to pursue ongoing learning and improvement, reflects in, on, and for action (p. 763).

These stages are a continuum and allow the learner to progress through various skills at different rates (Carraccio et al., 2008). The Dreyfus model clearly indicates that skills acquisition is an ongoing process, which ranges from novice to expert. ten Cate, Snell and Carraccio (2010) argue that individuals reach the level of competence on this spectrum by training and deliberate practice. Figure 2 outlines a curve of skills acquisition. Milestones will help guide the mode of assessment required (Green et al., 2009).

Figure 2 General Curve of skills Acquisition. (ten Cate et al., 2010). Dotted lines signify moments at which a trainee reaches a competence threshold or milestones.



While multiple assessment tools exist, and many more will be developed, the onus will be on faculty to use these tools appropriately. Kogan and Holmboe (2013) suggest that there has been an overemphasis on the tool and that it is the rater that needs "refining" (p. S71). Faculty often lack knowledge of how to use the assessment instruments (Dudek, Marks, & Regehr, 2005). Faculty development, buy in, and expertise will be an ongoing challenge. The goal of competency-based education is to develop expertise, although expertise is not the end goal of training but rather part of a continuum of ongoing assessment (Holmboe et al., 2010).

Faculty Development

A cooperative climate with proper training and support are key ingredients for a successful curricular change (Bland et al., 2000). Faculty will need to be involved in planning and implementing of the curriculum. Faculty will need to continue to probe learners on knowledge and reasoning skills, in addition to observing interviewing

skills, physical exam skills, counseling and so forth (Holmboe et al., 2011). With the implementation of CBME, there will be increased demand for the faculty to observe and assess learners in a frequent and timely manner. Teachers will need to understand and assess the competencies (Dath & Iobst, 2010). As many frameworks are already in existence, it is assumed that faculty will already be familiar with the intrinsic roles beyond that of medical expert. Holmboe et al. (2010) found that faculty may not be effective evaluators of learner's performance and often fail to identify deficiencies. This finding further highlights the need for faculty development particularly around observation, coaching skills and knowledge of the instrument. Fortunately, Steinert et al. (2006) found that faculty had improved attitude and behavior, better teaching skills and greater involvement in teaching when they participated in educational training activities. Briefing faculty on the purpose and importance of the observation and feedback, as well as the tool itself, improves the success of implementation of an assessment strategy (Norcini & Burch, 2007). Assessment drives learning. To promote learning, assessment should be formative and learners should receive specific feedback on how to build their knowledge and skills (Driessen & Scheele, 2013). The utility of WBAs is to "catalyze the learner" to drive future learning (Kogan & Holmboe, 2013, p. S69). Norcini and Burch, (2007, p.856) argued that feedback promotes learning in three ways:

- It informs the trainees of their progress or lack thereof;
- It advises trainees regarding observed learning needs and resources available to facilitate their learning; and

- It motivates trainees to engage in appropriate learning activities.

However, observation of trainees is lacking at both undergraduate and postgraduate training levels (Norcini & Burch, 2007). Though comprehensive exams and other summative measures exist, formative feedback from expert faculty members will be just as if not more important (Holmboe et al., 2011).

Chapter 2: The Purpose Statement and Research Question

Purpose:

This study has three primary purposes:

a) Facilitate the development and implement a pilot competency-based curriculum into the general pediatric component of the PGY 1 year at McMaster University, pediatric residency program.
b) Develop a tool, the Mini Milestones Assessment (Mini-MAS) to assess six medical competencies and progression through milestones using the Dreyfus Developmental Model and to pilot the tool in the general pediatric rotations for the PGY 1 and 4 residents.
c) Test the reliability, validity, acceptability and feasibility of the Mini-MAS tool.

Research Question:

Is the Mini-MAS a valid, reliable, acceptable and feasible tool for the assessment of milestones in history taking, physical exam skills, clinical reasoning, communication and collaboration for PGY 1 and PGY 4 pediatric residents in their general pediatric rotations at McMaster Children's Hospital?

Chapter 3: Methods

Developing the Curriculum:

In July 2013, the McMaster Pediatric Residency Program began implementing competency-based education for PGY 1 trainees. A two-day retreat was held to develop the curriculum including members of the residency training committee, general pediatric faculty and resident representatives from each year. The curriculum was implemented specifically for the general pediatric rotations as a pilot. The pilot would allow the introductions of these concepts to a smaller more manageable number of faculty while program evaluation was conducted. The PGY 1 residents' general pediatric experience occurs on the clinical teaching unit (CTU), in their community placements and on float call, which totaled 22 weeks spread throughout the year. The education model was developed into a competency-based education framework with learning outcomes, milestones and complimentary assessment.

Harden's (2007) nine steps (as previously described) were used in the implementation process:

1. Statement of learning outcomes
2. Communication with staff and students
3. Educational strategies
4. Learning opportunities
5. Course content
6. Student progression
7. Assessment
8. Educational environment
9. Student selection

Step 1. Statement of learning outcomes

The first step in Harden's model, the statement of learning outcomes, identifies 12 learning outcomes.

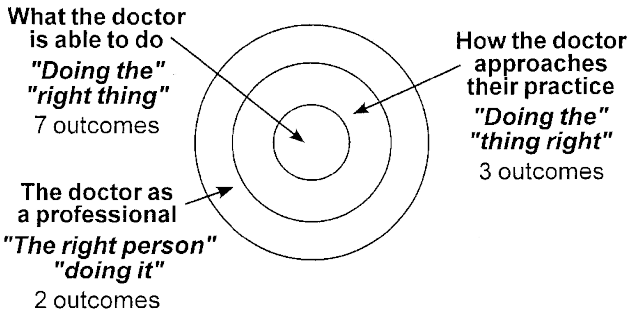


Figure 3. The Three-Circle Model for Outcome-Based Education. (Harden et al., 1999)

The twelve learning outcomes:

The first seven learning outcomes corresponding to the inner circle describe what the resident should be able to do at the end of training. These seven outcomes

can be clearly defined and are usually anchored to some observable behaviour. The learning outcomes are made up of discrete components of competence and should be taught as such and evaluated in performance-based assessments such as the objective structured clinical examination. The seven outcomes are:

(1) Competence in clinical skills: The resident should be competent to take a comprehensive, relevant medical and social history and perform a physical examination. He or she should be able to record and interpret the findings and formulate an appropriate action plan to characterize the problem and reach a diagnosis.

(2) Competence to perform practical procedures: The resident should be able to undertake a range of procedures on a patient for diagnostic or therapeutic purposes.

(3) Competence to investigate a patient: The resident should be competent to arrange appropriate investigations for a patient and where appropriate interpret these.

(4) Competence to manage a patient: The resident is competent to identify appropriate treatment for the patient and to deliver this personally or to refer the patient to the appropriate colleague for treatment. Included are interventions such as surgery and drug therapy and contexts for care such as acute care and rehabilitation.

(5) Competence in health promotion and disease prevention: The resident recognizes threats to the health of individuals or communities at risk. The resident is able to

implement prevention and health promotion. This is recognized as an important basic competence alongside the management of patients with disease.

(6) Competence in skills of communication: The resident is proficient in a range of communication skills, including written and oral, both face-to-face and by telephone. He or she communicates effectively with patients, relatives of patients, the public and colleagues.

(7) Competence to retrieve and handle information: The resident is competent in recording, retrieving and analyzing information using a range of methods including computers.

The second group of outcomes corresponds to the middle circle and describes how the resident approaches the seven competencies described in the first category.

(8) With an understanding of basic, clinical and social sciences: Residents should understand the basic, clinical and social sciences that underpin the practice of medicine. They are not only able to carry out the tasks described in outcomes one to seven, but do this with an understanding of what they are doing, including an awareness of the psychosocial dimensions of medicine and can justify why they are doing it (i.e. `academic intelligences').

(9) With appropriate attitudes, ethical understanding and understanding of legal responsibilities: Residents adopt appropriate attitudes, ethical behaviour and legal approaches to the practice of medicine. This includes issues relating to informed

consent, confidentiality, and the practice of medicine in a multicultural society. The importance of emotions and feelings is recognized as the `emotional intelligences'.

(10) With appropriate decision making skills and clinical reasoning and judgment: Residents apply clinical judgment and evidence-based medicine to their practice. They understand research and statistical methods. They can cope with uncertainty and ambiguity. Medicine requires, in some cases, instant recognition, response and unreflective action, and at other times, requires deliberate analysis, decisions and actions following a period of reflection and deliberation. This outcome also recognizes the creative element in problem solving that can be important in medical practice.

The last two outcomes relate to the outer circle and are concerned with the personal development of the resident as a professional the `personal intelligences'.

(11) Appreciation of the role of the resident within the health service: Residents understand the healthcare system within which they are practicing and the roles of other professionals within the system. They appreciate the role of the resident as physician, teacher, manager, collaborator, professional and researcher. This outcome implies a willingness of the resident to contribute to research even in a modest way and to build up the evidence base for medical practice. It also recognizes that most residents have some management and teaching responsibility.

(12) Aptitude for personal development: The resident has certain attributes important for the practice of medicine. He or she is a self-learner and is able to assess his or her

own performance. The resident takes responsibility for his or her own personal and professional development, including personal health and career development.

The Royal College CanMEDS Competencies (Frank, 2005) played an important part in the curriculum and were incorporated in the above learning outcomes (Appendix 1).

Step 2. Communication with Faculty

The faculty involved were given a 20-minute information session. The tool and purpose were reviewed with the faculty. An information sheet based on Weller et al. (2009) outlining the guidelines for completing the Mini-MAS was given to and reviewed with the faculty (Appendix 2).

Step 3. and 4. Educational Strategies & Learning Opportunities

In the present study, residents were exposed to a variety of clinical situations and teaching sessions.

i. Clinical Exposure-Total 22 weeks:
    a. CTU-4 weeks
    b. Community Waterloo-4 weeks
    c. Community Brampton-4 weeks
    d. Community St. Joseph's Healthcare-4 weeks
    e. Float call at McMaster-6 weeks

ii. Teaching sessions and Resources:
    a. Academic Half Day including Clinical Skills Days
    b. Simulation
    c. Longitudinal CanMEDS Competencies (LCC)

d. Journal Club
e. Department Grand Rounds
f. Division of General Pediatrics Grand Rounds
g. Morbidity and Mortality Rounds
h. CTU Teaching Sessions
i. Subspecialty Rounds
j. Work in Progress
k. Faculty Development Courses
l. Department Conferences
m. Neonatal Resuscitation Program (NRP)/ Pediatric Advanced Life Support (PALS) courses
n. Case Based Teaching Sessions (self directed)
o. Mac at Night Curriculum
p. PREP The Curriculum
q. Self Directed Modules: CPSO, RCPSC, CPS and Pedialink
r. Peer and Faculty Mentors

Step 5. **Course Content and Milestones:**

The medical expert content or knowledge was based on the Royal College objectives of training in pediatrics (Appendix 3). For skills and attitudes, we used the timelines for achievement as suggested by Green et al. (2009) These timelines gave both the learner and faculty an idea of the suggested developmental progression (Appendix 4).

Step 6. Student Progression:

Student progression was based on a comprehensive assessment program outlined below. Each PGY 1 resident had to meet the milestones and objectives successfully. The competency-based medical education curriculum was considered a comprehensive non-consecutive block of 22 weeks and thus residents had the full time period to achieve the stated objectives. Assessments at the end of each rotation block were formative to allow the resident to reflect on areas of improvement. At the end of their 22 weeks, all assessments were reviewed to see if the learner had met their objectives and reached the appropriate milestones.

Step 7. Assessment:

The residency program already had several assessment modes in place:

i. Objective Structured Clinical Exam (OSCE) twice a year.
ii. Multiple Choice Questions (MCQ) and Short Answer Questions (SAQ) twice a year.
iii. American Board of Pediatrics (ABP) In Training Exam, an MCQ exam held annually
iv. STACER- Structured Assessment of Clinical Encounter Report
v. Portfolio
vi. Multi-Source Feedback (MSF)
vii. Procedure Log Book

In addition to these, we implemented an end of rotation evaluation based on the suggested progression (Appendix 5) and the new Mini-MAS tool.

Step 8. Educational Environment:

Learners in the residency program spend the majority of their time in a collegial learning environment at McMaster Children's Hospital. The CTU experience as well as the float call was at that site. The learners also spent time in a general pediatric setting at three community sites: St Joseph's Healthcare Hamilton, Grand River Hospital, Kitchener and William Osler Health System, Brampton. All community sites have a collegial and friendly learning environment.

Step 9. Student Selection:

No changes were made to the selection process for learners to the residency program.

Developing the Tool:

The Pediatric Milestones Project (Pediatric Milestone Working Group, 2012) has developed 48 competencies, with each competence consisting of 4-5 developmental levels of performance or milestones. The anchors provide suggested behaviours for progression to competence (Englander et al., 2012). For this study, assessment was limited to six core competencies: history taking, physical exam, clinical reasoning, communication with families, communication with physicians and other health care professionals and collaboration (Appendix 6). The developmental levels of performance outlined by the milestones project were used to create the assessment tool. In order to allow evaluators to focus on one competency at a time, and to avoid any potential halo effect across competencies, each competency has its own assessment form rather than all listed on the same page. Faculty were instructed

to match observed behaviours of the learner with the anchors provided outlining the milestones trajectory. Each patient interaction was only used for a single evaluation. Faculty were also required to document the rotational setting and patient problem to ensure skills were being assessed across multiple contexts and to record their satisfaction with the tool.

Participants:

A total of 21 residents were included in the study. 12 PGY 1 residents at McMaster Children's Hospital were required to have completed 40 unique observations in six domains (10 history taking, 10 physical exam, 5 clinical reasoning, 5 communication with families, 5 communication with staff and 5 collaboration) during their general pediatric rotations and float call for the 2013-2014 academic year. The number of cases for each was determined by consensus of the residency training committee. The twenty-two weeks of training were distributed throughout the year and different for each resident's schedule. During the twenty-two weeks, approximately eighty percent of the evaluations were to be completed by faculty and twenty percent by senior residents. In addition to the 12 PGY 1 residents, 9 PGY 4 residents were observed performing the same competencies over the same time period. This senior group was required to complete 15-20 encounters, as their general pediatric exposure was less during this final year of training. Only faculty conducted the PGY 4 evaluation.

Procedure:

The learners were observed during their general pediatric clinical experiences at four sites: the CTU at McMaster Children's Hospital, St. Joseph's Health Care, Grand River Hospital and William Osler Health System. In addition, they were observed during their float call. PGY 4 residents also had further opportunity to be observed in the Senior Resident Clinic (SRC) by faculty members. It was the learner's responsibility to ensure an observation occurred and a form was completed; they were advised to prearrange with the faculty the time and competency being evaluated. The learners were also advised to attempt two observations per week during the twenty-two weeks of general pediatric experience to ensure a longitudinal assessment occurred.

Assessors:

All assessors were either general pediatric faculty at one of the four sites or senior residents. Assessors were instructed to observe the competency being assessed. In order to improve compliance, faculty were also told they did not need to observe a full patient encounter. A guideline of 5-15 minutes was given for each observation. The assessor would then immediately complete the Mini-MAS form and provide immediate feedback. All forms were completed in duplicate copies.

Other Data:

Data were also collected from other assessment tools currently in the program including OSCE, MCQ and SAQ exams written twice a year, fall and spring and mini-CEX evaluations that were completed monthly in all other specialty rotations.

The mini-CEX differs from the Mini-MAS in that it evaluates residents' competence in multiple areas: interviewing, physical examination, professionalism, clinical judgment, counseling, organization and overall competence on a 9 point unanchored scale, although not areas have to be assessed (Appendix 7).

Post-Implementation Survey:

A short survey was sent to all residents and assessors after the end of the academic year for their feedback. Residents and assessors were asked to rate their satisfaction with the Mini-MAS tool, the process of getting the assessment done value of the feedback and further suggestions for faculty development (Appendix 8). A seven point scale was used from strongly disagree to strongly agree. Senior residents filled out both surveys as they were assessors for junior trainees and were also evaluated.

Statistical Analysis:

Psychometric theories were used to evaluate the quantitative data. Reliability, validity, feasibility and acceptance are important in determining the usefulness of an assessment method. Reliability is the degree to which the measurement is accurate, reproducible and generalizable (Epstein, 2007; Schuwirth & van der Vleuten, 2011; Van Der Vleuten & Schuwirth, 2005). Validation of the test is an indication of whether the test measures what it purports to measure in the applied circumstances. Validity refers to the score interpretation, not the measurement tool itself (Schuwirth & van der Vleuten, 2011) and provides evidence to either support or refute the interpretation of the results (Downing, 2003). Validity can be described in terms of

content, criterion and construct validity. The concept of validity has changed over time (Schuwirth & van der Vleuten, 2011). The work by Kane (2001) provides a useful interpretation of validity analysis and Clauser, Margolis and Swanson (2008) have adapted Kane's theory for medical education. According to Kane, validity is made up of four components: scoring, generalization, extrapolation and interpretation/decision. Table 2 outlines these four components and some of the relevant questions related to these components (Clauser et al., 2008; Hawkins et al., 2010).

Table 2: Components of Kane's Validity

Component	Questions
Scoring	1. Was the assessment properly administered? 2. Did the learner know when they will be observed and what behavior will be assessed? 3. Were the observations of construct the same in different contexts? 4. Were the procedures for scoring the performance consistently and accurately applied? 5. Are the raters appropriately selected and trained?
Generalization	1. Is the sample of observations representative of the larger universe of observations? 2. Is the sample large enough to produce reliable results? 3. What are the results of reliability of generalizability analysis?
Extrapolation	1. Do the ratings correspond to what actually happens in the real world? 2. Are there factors that interfere with the assessment? 3. Do the scores predict real world outcomes? 4. How do observed scores correlate with other methods assessing the same or similar construct?
Decision	1. Are interpretations and or decisions established a defensible and properly implemented procedure? 2. What are the consequences of interpretations based upon the scores? 3. Do the rules applied to summative decisions based on scores make sense based on expectations for a trainee-level? 4. Do trainees identified for remediation improve with a domain specific educational intervention?

In the present study, feasibility and acceptability were assessed by the post-implementation survey and completion rate of the forms overall and for specific competencies. Residents and assessors completed a short survey two months after the completion of the study assessing their satisfaction with the tool and the process. Acceptability was further assessed by analyzing the scores of satisfaction on each form completed by assessors.

Chapter 4: Data Presentation

Encounters and Participants

12 PGY 1 residents completed 474 forms, although 39 were subsequently removed as untrained assessors completed them. A total of 435 forms were included averaging 36 per resident. Of the 9 PGY 4 residents, one lost his book, and another went on a medical leave of absence, leaving 7 PGY 4 residents. This group completed 96 forms averaging 16 forms per resident.

There were 45 different assessors who assessed more that one resident, eight of which were senior residents. The residents were assessed in a wide variety of general pediatric settings, including the CTU, emergency room, office, clinic and the community setting. The clinical problems specified by the evaluators covered a broad range of problems in pediatrics. Table 3 outlines the average number of forms per competency completed. PGY 1 residents had defined requirements for each competency, while PGY 4 residents' requirement was a total number of evaluations completed.

Table 3: Average Number of Forms Per Competency

	Coll.	ComF	ComHCP	ClinRe	Hist	PE	Total
PGY 1 Requirements	5	5	5	5	10	10	40
PGY 1 Average	4	6	5	5	8	9	36
PGY 4 Requirements	N/A	N/A	N/A	N/A	N/A	N/A	15-20
PGY 4 Average	2	5	2	4	2	2	16

Coll: Collaborator
ComF: Communication with Families
Com HCP: Communication with health care professionals
ClinRe: Clinical Reasoning
Hist: History taking
PE: Physical Examination skills

Figure 4 and 5 outline the competencies completed per quartiles for the academic year for both training groups. 20 evaluations were not included, as they did not have a date recorded, thirteen from the PGY 1 group and seven from the PGY 4 group.

Figure 4: Competencies Completed Per Quartile PGY 1

	Coll	ComF	ComHCP	ClinRe	Hist	PE	Total
Quart 1	3	11	11	10	20	5	60
Quart 2	9	19	13	20	16	13	90
Total 2013	12	30	24	30	36	18	150
Quart 3	13	19	16	16	25	20	109
Quart 4	26	16	18	14	34	55	163
Total 2014	39	35	34	30	59	75	272

Quartile 1: July-September 2013
Quartile 2: October-December 2013
Quartile 3: January-March 2014
Quartile 4: April-June 2014

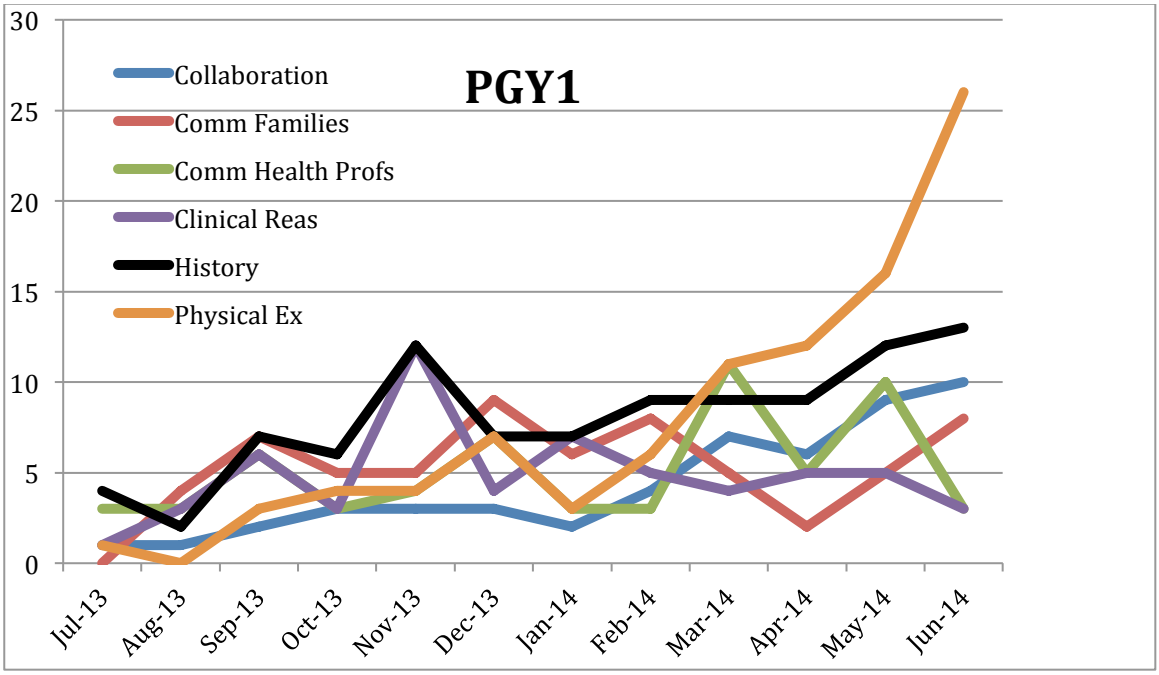
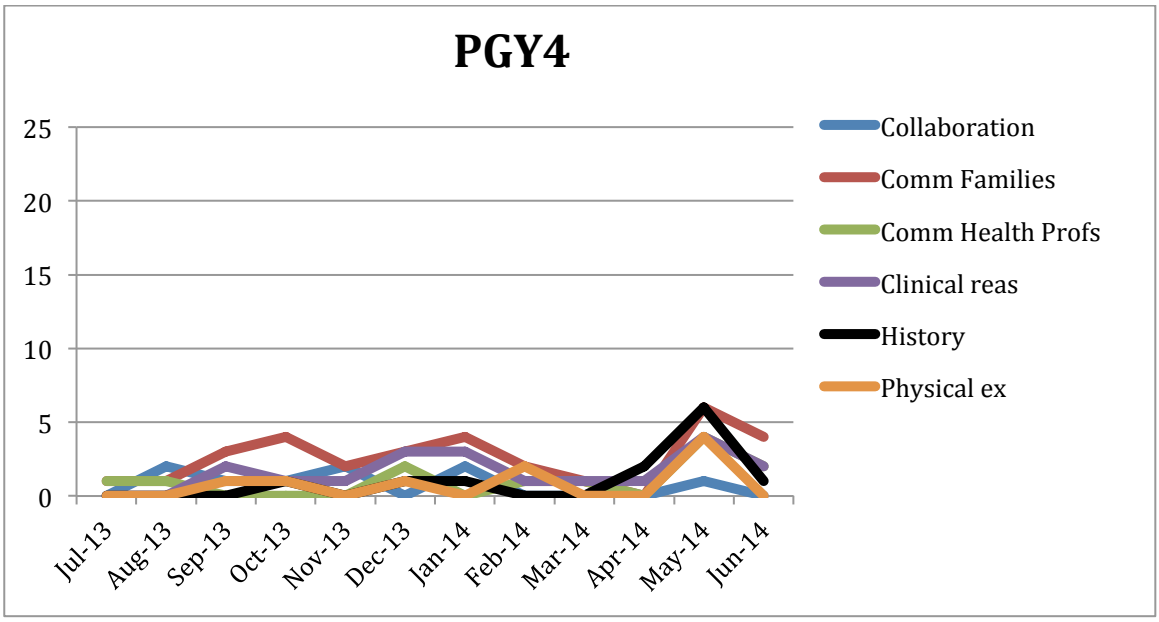


Figure 5: Competencies Completed Per Quartile PGY 4

	Coll.	ComF	ComHCP	ClinRe	Hist	PE	Total
Quart 1	3	8	4	3	1	1	20
Quart 2	3	6	2	5	2	2	20
Total 2013	6	14	6	8	3	3	40
Quart 3	2	4	1	2	1	1	11
Quart 4	4	6	7	8	9	4	38
Total 2014	6	10	8	10	10	5	49

Quartile 1: July-September 2013
Quartile 2: October-December 2013
Quartile 3: January-March 2014
Quartile 4: April-June 2014



The residents were to have 80% of their forms completed by faculty and 20% by senior residents; Table 4 outlines the total percentage completed by each group as well as by each competency. The average score given by senior resident assessors and faculty assessors for each competency is shown in Table 5. A student t test was used to compare the groups.

Table 4: Percentage of Competencies Observed by Faculty Versus Senior Residents

	Faculty %	Senior Resident %
Coll	67%	33%
ComF	73%	27%
ComHCP	82%	18%
ClinRe	81%	19%
Hist	80%	20%
PE	71%	29%
Total	76%	24%

Table 5: Average Scores Given by Senior Resident and Faculty Assessors

	Faculty	Senior Resident	P
Coll	3.7	4.1	0.184
ComF	3.5	3.7	0.483
ComHCP	3.4	3.8	0.278
ClinRe	3.2	3.5	0.237
Hist	3.6	3.8	0.389
PE	3.5	4.0	0.058

The evaluators used mainly two to five on the Mini-MAS scale rarely using the score one or the most novice category for the PGY 1 group, and used mainly scores four and five for the PGY 4 residents (Table 6).

Table 6: Frequency of each score PGY 1 and PGY 4 Residents

Score	PGY 1	PGY 4
1	**0.5%**	**0.0%**
2	**7.9%**	**0.0%**
3	**37.3%**	**2.1%**
4	**44.7%**	**42.7%**
5	**9.6%**	**55.2%**

Table 7 reflects the "starting point" for PGY 1 residents; the table outlines the frequency of scores for each competency in the first quartile. Table 8 outlines similar scores for PGY 4 residents. The first two quartiles were combined to get enough data points.

Table 7: The Frequency of Scores for Each Competency in the First Quartile For PGY 1 Residents

Scores	Coll.	ComF	ComHCP	ClinRe	Hist	PE
1	-	-	-	-	-	40%
2	-	27.3%	18.2%	30%	25%	-
3	33.3%	45.5%	45.4%	70%	25%	20%
4	66.6%	18.1%	36.4%	-	45%	20%
5	-	9.1%	-	-	5%	20%

Table 8: The Frequency of Scores for Each Competency in the First and Second Quartiles For PGY 4 Residents

Scores	Coll.	ComF	ComHCP	ClinRe	Hist	PE
1	-	-	-			
2	-	-	-			
3	-	7.1%				33.4%
4	83.3%	42.9%	28.6%	50%	66.6%	66.6%
5	16.7%	50%	71.4%	50%	33.4%	

Reliability

Reliability was calculated through generalizability theory using urGenova and the Statistics Package for Social Sciences (SPSS) software. An ANOVA was carried out by identifying the trainee (t), competence subsection (s) and observer (o). A generalizability coefficient (G) was also calculated. The G-coefficient provides a measure of confidence that any differences detected between residents are real (Crossley, Davies, Humphris, & Jolly, 2002). The overall generalizability was assessed for the overall Mini-MAS (t and s) for the PGY 1 and PGY 4 groups. Observers were not included in these calculations, as each observer did not assess every candidate and some observers may have assessed the same candidate for different competencies during the academic year. A G coefficient for each competence (s and o) for the PGY 1 group was also calculated. There was insufficient data for the PGY 4 group. Table 9 highlights these results. Table 10 details the variance components for the overall G-coefficient showing most of the variance for PGY 1 residents comes form the differences across trainees.

Table 9: G coefficient

	PGY 1	**PGY 4**
Overall	0.78	0.50
Coll	0.27	N/A
ComF	0.74	N/A
ComHCP	0.37	N/A
ClinRe	0.47	N/A
Hist	0.62	N/A
PE	0.30	N/A

Table 10: Variances for G-Coefficient for Overall Score for PGY 1 and PGY 4 Residents

Facet	PGY 1		PGY 4	
	VC	% of VC	VC	% of VC
t	0.055	73.3%	0.019	41.2%
s	0.004	5.3%	0.005	11.6%
ts	0.016	21.3%	0.019	41.2%
G-coefficient	0.78		0.50	

VC= Variance Component

A D study was conducted following the G study. A D study is when a G coefficient is modeled from pilot data; it predicts reliability across different test situations (Crossley et al., 2002). Results of the D-Study study are presented in Table 11 for the individual competencies for the PGY 1 residents with increasing the number of observations.

Table 11: D Study for Individual Competencies for PGY 1 Residents

Competency	D-Study Adjusted G-coefficient	Number of Observation
Coll	0.35	10
ComF	0.825	10
ComHCP	0.489 0.535	10 12
ClinRe	0.567	10
Hist	0.658	12
PE	0.343 0.395	12 15

Validity

Construct validity was evaluated by examining if the tool was able to discriminate between levels of seniority. Using a paired t test, we looked at the PGY

1 and PGY 4 residents' overall progress between the first and second half of the academic year and for each competency measured for just the PGY 1 residents (Table 12). We did not have enough data for the PGY 4 residents to run comparisons for each competency. The difference between the PGY 1 residents and PGY 4 residents overall and for each competency was analyzed by using a one-way ANOVA and is shown in Table 13. Though trainee discrimination is often used as construct validity it contributes only weak validity evidence, as the differences in scores of the PGY 1 and PGY 4 trainees would be plausible due to novice-expert differences (Cook, Zendejas, Hamstra, Hatala, & Brydges 2014).

Table 12: A Comparison of PGY 1 and PGY 4 Residents' Scores Between the First and Second Half of the Academic Year

PGY 1	**July to Dec. 2013**	**Jan. to June 2014**	**p**
Overall	3.3	3.8	0.001
Coll	3.6	3.8	0.5
ComF	3.1	3.9	< 0.05
ComHCP	3.1	3.7	< 0.05
ClinRe	3.0	3.7	< 0.05
Hist	3.3	3.7	0.3
PE	3.0	3.8	0.1
PGY 4	**July to Dec. 2013**	**Jan. to June 2014**	p
Overall	4.4	4.7	0.25

Table 13: A Comparison of Overall PGY 1 and PGY 4 Residents' Scores

	PGY 1	PGY 4	F	p
Overall	3.54 (± 0.26)	4.46 (± 0.19)	57.7	0.0001
Coll	3.81 (± 0.30)	4.17 (± 0.41)	4.6	0.05
ComF	3.50 (± 0.53)	4.71(± 0.32)	25.9	0.0001
ComHCP	3.43 (± 0.33)	4.38 (± 0.25)	32.2	0.0001
ClinRe	3.28 (± 0.34)	4.72 (± 0.25)	85.6	0.0001
Hist	3.56 (± 0.43)	4.39 (± 0.44)	15.1	0.001
PE	3.63 (± 0.33)	4.40 (± 0.57)	13.1	0.0001

Pearson Correlation was used to examine the relationship between Mini-MAS competencies with one another for both groups of residents. Results of the PGY 1 and PGY 4 data are shown in Table 14. A moderate correlation would be an r = 0.4-0.6 and a high correlation would be an r = 0.7-0.9.

Table 14: Correlations (r) Between Mini-MAS Competencies PGY 1 and PGY 4

PGY 1	Coll.	ComF	ComHCP	ClinRe	Hist	PE
Coll		0.05	0.14	0.17	0.19	0.09
ComF			0.26	0.31	0.53	0.76*
ComHCP				0.36	0.30	0.46
ClinRe					0.50	0.46
Hist						0.84*
PE						
PGY 4	**Coll.**	**ComF**	**ComHCP**	**ClinRe**	**Hist**	**PE**
Coll		-0.5	0.0	-0.4	-0.4	-0.4
ComF			-0.3	0.6	-0.05	0.6
ComHCP				0.04	0.8	0.3
ClinRe					0.6	1.0*
Hist						0.7
PE						

* $p < 0.01$

Concurrent validity was assessed by examining the correlation between Mini-MAS scores with other assessment tools, including MCQ, SAQ, the OSCE exam conducted semi annually for all residents in the program, and the mini-CEX evaluations that were conducted on non-general pediatric rotations. Individual Mini-MAS competencies had little correlation with the individual mini-CEX competencies, which included medical interviewing, physical examination, humanistic qualities/professionalism, clinical judgment, organization and overall score. The only significant correlations were the mini-CEX competency of organization and the Mini-MAS competencies of communication with families (0.79, $p < 0.01$), physical examination (0.65, $p < 0.05$) and overall score (0.73, $p < 0.05$).

There was no correlation between the Mini-MAS competencies or overall score with the OSCE, MCQ or SAQ exams. The MCQ and SAQ did not correlate with the OSCE. The overall mini-CEX score did correlate with the OSCE score but not with the MCQ or SAQ. There was significant correlation between the competencies of the mini-CEX (Table 15).

Table 15: Correlations Between Mini-CEX competencies

	Interview	PE	Humanistic Qualities	Clinical Judgment	Counsel	Organization	Overall
Interview		0.58	0.86**	0.74*	0.66*	0.72*	0.95**
PE			0.36	0.27	0.23	0.38	0.54
Humanistic Qualities				0.94**	0.68*	0.85**	0.88**
Clinical Judgment					0.64*	0.73*	0.77*
Counsel						0.38	0.55
Organization							0.82**

PE= Physical Exam * $p < 0.05$ ** $p < 0.01$

Survey Data

17 of 19 residents completed the survey, 10 (83.3%) PGY 1 and 7 (87.5%) PGY 4 residents. Table 16 outlines the means for the resident and assessor surveys. In general the PGY 4 residents found more value in the Mini-MAS than the PGY 1 residents (4.6 to 3.8). 22 of 45 assessors completed the survey, 19 from the McMaster site, two from the Waterloo site and one from the Brampton site. The majority of the Mini-MAS forms were completed by McMaster assessors. Assessors seemed more satisfied with the Mini-MAS tool than residents and found it more valuable. Assessors generally were neutral when asked if they wanted more training using the tool (3.6) although they reported wanting more training on how to provide effective feedback (4.3). The assessors felt the assessment did add to their workload (4.7).

Table 16: Survey Results of Assessors, PGY 1 and PGY 4 Residents

	PGY 1	PGY 4	Faculty	
Overall Satisfaction	**3.8**	**4.6**	**5.3**	**Overall Satisfaction**
Faculty agreeable to assessing	**3.9**	**5.3**	**5.8**	**Faculty felt they were engaged**
Remembering to request and observation	**3.5**	**3.4**	**N/A**	
Remembering to request prior to assessment	**3.9**	**3.9**	**4.8**	**Generally asked to observe prior to encounter**
Timely completion of form	**4.8**	**5.3**	**5.3**	**Timely completion of form**
Timely verbal feedback	**5.1**	**6.0**	**6.2**	**Provided Verbal Feedback**
Value of verbal feedback	**5.3**	**5.0**	**5.6**	**Value of verbal feedback**
Tool helped increased number of observation	**4.0**	**4.9**	**5.1**	**Tool helped increased frequency of observation**
Tool positively influenced learning	**3.6**	**5.1**	**N/A**	**N/A**
Continue using Mini-MAS	**3.9**	**4.7**	**5.4**	**Continue using Mini-MAS**

1 = strongly disagree, 7 = strongly agree

Some common themes were identified in the comment section for the resident survey. Residents felt the tool influenced their learning and helped increase their observations by faculty: " I do believe this will influence my learning positively", "the Mini-MAS book is a good tool for assessing the learners in their visual environment" and "The Mini-MAS is arguably a good tracking tool…given the culture of medicine and the temptation for trainees to avoid supervision". Residents did comment on the burden of getting the assessments, as well as the size of the book itself. Two residents commented on the descriptors being too long and hard to decipher. In the faculty survey, a common theme about the descriptors emerged. Faculty generally felt the descriptors were too long. Other comments included the need for a culture change to make this an effective assessment process; "In order to implement something like this the whole approach to evaluation needs to be changed it is a culture shift".

Assessors also had to complete an overall satisfaction with the Mini-MAS each time they completed the form, the average score was a 7.7 on a nine-point scale.

Chapter 5: Discussion

In this section, each component of Kane's validity argument is described.

Scoring

1. Was the assessment properly administered?
2. Did the learner know when they will be observed and what behavior will be assessed?

3. Were the observations of construct the same in different contexts?
4. Were the procedures for scoring the performance consistently and accurately applied?
5. Are the raters appropriately selected and trained?

The process of getting the Mini-MAS observations completed seemed to flow smoothly. Both PGY 1 and PGY 4 residents completed 90% or greater of the required assessments (Table 3). 80 % of the observations were to be completed by faculty; in this study, 76% were completed by faculty (Table 4). There was a trend of more observations being done in the second half of the year for the PGY 1 residents, particularly for the physical exam competency (Figure 4). This maybe due to the fact that this was a new process and the PGY 1 residents are still getting used to being a resident and feeling comfortable asking faculty to observe them. Faculty often will watch residents conduct a history or provide counseling and very commonly assess their clinical reasoning skills, the physical exam is often not observed. This may account for the spike in the later part of the year as residents needed to complete the required competencies. Some PGY 1 residents did find it difficult to complete the required number of assessments as seen by the neutral rating of faculty engagement (3.9) by the PGY 1 raters (Table 16). PGY 4 residents however found the faculty more engaging (4.6), but are also more familiar in working with faculty, and likely have developed rapport and comfort with the faculty. Looking at the average score given for each competency by resident assessors and faculty, the residents were more lenient in their scoring across all competencies but there were no significant

differences noted (Table 5). This may allow for more observations and assessments to be done by residents and may improve the acceptability of the tool. The learners were to ask assessors to observe them on a particular competency and the assessors were then to complete the assessment and provide feedback immediately. The residents and faculty both agreed on the survey that this occurred. The assessments were completed in a wide variety of general pediatric contexts covering a broad range of general pediatric topics.

Results from the survey indicated that faculty felt appropriately trained for using the Mini-MAS tool, they felt they completed the forms in a timely manner and provided valuable feedback (Table 16).

The scale on the Mini-MAS tool was utilized appropriately in the assessment of residents. For the PGY 1 residents', scores ranged from two to five, with the score of one (e.g., the novice category) not being used by raters (Table 6). The PGY 1 residents were rated mainly around the three to five categories. Looking at the individual competencies in the first quartile (Table 7), the PGY 1 residents had different level of skills for the different competencies at the start of their residency generally between scores two and four, the physical exam scores were lower than other scores in the first quartile indicating lower skill level for physical exam assessment for the PGY 1 residents at the start of their residency. However more data would be needed to further look at this trend. The PGY 4 residents' scores were mainly around four and five with very little to no use of the lower scores (Table 6). Their scores on the individual competencies reflected the same trend, but also showed

weaker physical exam skills than expected for their level of training (Table 8). The anchors are based on a development progression model with one being novice and five being expert. However, there is no data on these anchors to what constitutes where the milestones falls with regards to the level of training (Schumacher et al., 2014). This data shows that perhaps a PGY 1 resident should be around categories two to four, but further work around this is needed with a larger sample size. The PGY 4 scores also fit with the developmental progression model; these learners are close to ready for practice and should be scoring at the competent areas of the scale labeled expert on the Mini-MAS tool.

The competencies on the Mini-MAS did not correlate with each other (Table 14). This is a positive finding, as residents should not be expected to be at the same level in all competencies, supporting the idea of independence of ratings, competency-based training and assessment. In this study there was high correlation for competencies in the mini-CEX (Table 15), a weakness noted in other studies suggesting a halo effect when faculty are asked to observe more than one competency (Hawkins et al., 2010).

Faculty and residents both noted that the descriptors were long and at times vague in terms of differentiating the levels of progression, and this may have affected the scoring.

Generalization

1. Is the sample of observations representative of the larger universe of observations?
2. Is the sample large enough to produce reliable results?
3. What are the results of reliability of generalizability analysis?

For work-based assessment, the specific items of interest would be the number and diversity of both encounters and raters. In this study, we had 435 encounters for the PGY 1 residents (mean = 36 per resident) and 96 encounters for the PGY 4 residents (mean = 16 per resident). There were a broad variety of cases in a variety of settings. 45 raters evaluated the 19 residents included in the study. There was sufficient data to calculate the overall G coefficient for the PGY 1 and PGY 4 group. The PGY 1 group had enough data to calculate the G coefficient for the individual competencies (Table 9), enough data was not available to do the same for the PGY 4 group. The G coefficient overall was 0.8 for the PGY 1 group, indicating and ability of the tool to differentiate between the junior learners themselves. The variance analysis showed the majority of the variance was from the trainee as would be expected (Table 10). For the PGY 4 group, the G coefficient was 0.5. This lower coefficient is not unexpected, the PGY 4 group would be a more homogeneous group as they would be coming to the last year of training having achieved many of the milestones observed thus accounting for the lower coefficient. Looking at the frequency of scores for the PGY 4 residents in the first and second quartile supports this as most PGY 4 residents started with scores of 4 or 5. A D-study conducted

showed increasing the number of observations to 10-12 for the PGY 1 trainees could increase the G-coefficient to acceptable levels for history taking, communication with families, communication with health care professionals and clinical reasoning (Table 11). This is similar to the mini-CEX (Norcini et al., 2003). However, in our study each competency will require 10-12 observations as opposed to 10-12 observations overall for the mini-CEX.

For the collaboration and physical exam skills increasing the observations did not increase the coefficient. This may be related to the anchors and ability to differentiate the levels of scoring. Faculty and residents both commented that some levels of scoring were hard to differentiate based on the anchors.

Extrapolation

1. Do the ratings correspond to what actually happens in the real world?
2. Are there factors that interfere with the assessment?
3. Do the scores predict real world outcomes?
4. How do observed scores correlate with other methods assessing the same or similar construct?

The strength of the Mini-MAS is that it involves observation of what really happens in clinical practice across a variety of settings. However, some residents may not perform optimally when observed directly, and this may affect their assessment. The PGY 1 residents had to ask faculty to have an assessment done, and PGY 1 residents reported that sometimes that was a challenge. For an early trainee, asking

faculty to observe and assess them may be intimidating and may affect their true assessment.

There was a clear progression of skills as PGY 1 residents progressed through the year as demonstrated by the significant improvement of their scores overall and in the competencies of communication with families, health care professionals and clinical reasoning (Table 12). The remaining three competencies, collaborator, history taking and physical exam did show an increase in scores through the year, however they did not reach significance. PGY 1 residents were already scoring high on the collaborator role in the first half of the year and this may account for the change not being significant. In addition the assessments for collaboration occurred more in the second half of the year. This was the same for history taking and physical exam skills, both assessments occurring more frequently in the last part of the year which may account for the lack of significance (Figure 4). The PGY 4 residents overall scores did show an increase in scores but were not significant. PGY 4 residents are in their final year of training and should be fine tuning their skills rather than developing skills. The benefit to the senior learner would be the feedback rather than the score. The CanMEDS 2015 framework from The Royal College of Physicians and Surgeons of Canada proposes that the final exam be moved earlier and that the last part of training be a transition to practice after the completion of the exam (Frank et al., 2014). The PGY 4 data from this study suggests that for the six competencies looked at, the PGY 4 residents are at a competent level already and would support the Royal College proposal. PGY 4 residents would then master their

skills already acquired during the transition period. The significant difference between PGY 1 and PGY 4 residents overall and in all the competencies provides further support for extrapolation (Table 13). The study was conducted as residents participated in their day-to-day clinical activities; thus faculty were not blinded to the level of training of the resident. This may affect the score as faculty may be more likely to score a PGY 4 resident higher than a PGY 1 resident.

This study did not look at correlation with exit high stakes exams nor how residents do in practice. There were comparisons done with concurrent assessment tools used in the program, the mini-CEX, MCQ, SAQ and OSCE exams. The only significant correlations were the mini-CEX competency of organization and the Mini-MAS competencies of communication with families, physical examination and the overall score. All the later three competencies require organization skills, and so organization may be indirectly measured with these observations. The fact that the Mini-MAS and MCQ, SAQ and OSCE did not correlate may be due to a lack of sufficient statistical power. It may also speak to the fact that they likely measure different aspects. The MCQ and SAQ measuring knowledge, the OSCE measuring application of that knowledge. All three of these assessment tools conducted under artificial conditions. The Mini-MAS is an assessment closely resembling practice of individual competencies measuring the "DOES" of Millar's Pyramid.

Decision

1. Are interpretations and or decisions established a defensible and properly implemented procedure?
2. What are the consequences of interpretations based upon the scores?
3. Do the rules applied to summative decisions based on scores make sense based on expectations for a trainee-level?
4. Do trainees identified for remediation improve with a domain specific educational intervention?

Theoretically, one might expect learners to progress from novice to expert during training. The fact that there is progression of scores through the academic year and that there is a difference between levels of training makes these scores defendable. Learners that fall below the level of training or are not progressing based on their Mini-MAS scores should be assessed for remediation for the competency of concern. This study did not look at the effect remediation and improvement in scores. This tool however is formative, making feedback an important component of the process. In the survey conducted, residents and faculty both reported that the implementation of the tool improved the frequency of observation, and that valuable feedback was provided (Table 16). The PGY 4 residents further reported the assessment process influenced their education. The PGY 1 residents did not find the same benefit. Malhotra et al. (2008) had similar findings, noting residents perceived the mini-CEX as anxiety provoking, but overtime saw educational value in the tool.

Acceptability and Feasibility

There was a high completion rate of the assessment at all levels of training. The residents and faculty were satisfied with the assessment tool as noted on the survey. The PGY 1 residents had a lower level of satisfaction, which may be due to some of the barriers they faced getting the assessment done. Asking faculty to observe them at their early level of training likely the most relevant factor. The faculty rated their overall satisfaction with the tool each time they completed the form, with the average rating being 7.7 on a nine-point scale. The faculty felt well trained, reporting that they did not need further training, but could benefit from sessions on effective feedback. As would be expected there was an increase in workload reported for faculty. One resident did lose his book. The paper nature of this tool and size of the book may affect the acceptability, however this also allowed for the forms being completed immediately and written feedback provided in a timely manner.

Conclusions

In the era of social accountability and demands for efficiency, organizations are moving to a competency-based education model in place of the historical time-based model. Competency-based education hopes to develop a competent holistic physician as trainees graduate and move to real practice and develop expertise. Key to the survival and acceptance of this shift in paradigm will be the proper assessment of learners.

Multiple modes of assessment are necessary to evaluate different aspects of competencies. Validated measures of knowledge, skills and attitudes need to be developed within the context of work based assessment tools. The need for observation and feedback is integral in this process. Our residency program implemented a pilot competency-based program that involved the creation and implementation of a work-based assessment tool. Moving away from likert scale measurements, the Mini-MAS is a criterion referenced assessment tool with clear anchors to ground the ratings. Faculty matched observed behaviors with descriptors along a developmental milestones trajectory independent of the level of training (Schumacher et al., 2014). Kogan & Holmboe (2013) defines a work-based assessment tool as one that assesses trainees across the continuum of competencies in clinical environments enabling the evaluation of performance in context. The Mini-MAS achieved that goal. The purpose of our study was to measure the reliability, validity, acceptability and feasibility of the tool. Using Kane's framework of validation we were able to show that there are strengths and areas to improve on.

Strengths of the Mini-MAS

The Mini-MAS was administered appropriately, with faculty and learners aware of the process of implementation. Residents were observed on six different competencies in a variety of clinical scenarios by multiple assessors. Correlation between competencies was low, being a strength achieved by assessing only individual competencies and having grounded anchors. There is no data on where an early, mid level or senior resident should fall on the 5 points of the tool (Schumacher

et al., 2014). The data from this study suggests normative ranges for transition of one milestone level to another. Almost no resident were at the novice level, the PGY 1 residents scored between two and five and the PGY 4 residents mainly in the expert area with scores of four to five. This certainly will facilitate programs and educators to know where a resident "should be" within the scale, more data will advance this information. It seems clear that the novice category may be the level of an undergraduate trainee.

Our analysis showed a G coefficient of 0.8 for the PGY 1 residents and 0.5 for the PGY 4 residents for the overall Mini-MAS score. We didn't achieve similar numbers for the individual competencies likely due to a small sample size and possibly due to the anchors not clearly differentiating the different levels.

The results did demonstrate progression through the academic year as well as from the PGY 1 to PGY 4 level, supporting the anchors based on the Dreyfus model. Theoretically the Mini-MAS assesses constructs similar to the mini-CEX and the OSCE. The results though did not show a correlation. As MCQ and SAQ measure different constructs to the Mini-MAS, a correlation was not expected. This supports the notion of longitudinal multi modal assessment program for any training program to assess constructs at all levels of Millar's Pyramid.

The final argument in Kane's framework focuses on how the scores will be used. Further validation will need to occur before this tool can be used in high stakes situations. However, we have enough supporting evidence to identify a learner that is

not progressing along the continuum for the six individual competencies assessed. This tool would help identify the exact area of weakness unaffected by the other areas assessed. It is fair to say that these individuals may benefit from remediation, though it is unclear if their scores would improve with remediation, as this was not evaluated. The strength of the tool though is that it increases the frequency of observation and learners receive valuable feedback that can positively influence learning. Clinicians are often reluctant to provide honest feedback; having defined learning outcomes makes it easier to provide guidance based on the observations itself (Norcini & Burch, 2007). Assessors can use the descriptors to guide the learner, provide them a plan for achieving the next level of competence.

Work based assessment tools should achieve three requirements: the competences expected as outcomes and the assessment should be aligned; feedback is provided during and/or after the assessment and the assessment is used to guide a trainee towards a desired outcome (Norcini & Burch, 2007). The Mini-MAS tool has achieved these three requirements and as suggested by Driessen & Scheele (2013) has shifted the focus from assessment of the trainee to learning of the trainee.

Though the study was conducted in the PGY 1 and PGY 4 group in pediatrics, the tool itself is not pediatric based and is designed to be used at all levels of training. The competencies assessed were generalizable to any area of medical training, allowing this tool to be used and studied in other disciplines.

The Mini-MAS added as a formative assessment mode to a multi-modal assessment program will benefit the trainee, informing them on where they stand compared to their level of training, what competencies they can improve on and how they can do that. More studies need to be done before it can be used in high stakes decision-making tool.

Limitations of the Study

Some areas for improvement would include having scheduled assessments during regular clinical duties to take away the resident having to ask for an assessment, which also may improve on the acceptability. As the culture shifts to frequent assessment, this is more likely to occur. The anchors were long and noted to be vague in some instances. With further use and evaluation of the tool, this can be modified.

Predicting subsequent clinical competence and patient satisfaction is a challenge (Hawkins et al., 2010; Kogan & Holmboe, 2013; Wass, Van der Vleuten, Shatzer, & Jones, 2001). This would involve a long-term follow-up of a large number of learners and was not done in our pilot study.

Future Direction

The current study was a pilot study and involved only the PGY 1 and PGY 4 residents. The sample size was relatively small. Though the clinical scenarios were broad, the study was contained within the general pediatric realm with dedicated

teaching faculty. Future direction would include making modifications as suggested by this study and expanding the study to include other years in training. Some of the changes include:

1. Having scheduled assessments weekly, rather than the learner asking, this however will require a culture change as faculty get accustomed to frequent assessment.
2. As there was no statistical difference in scores given between resident and faculty assessors, consider more assessment by senior residents or fellows to improve acceptability.
3. Simplifying and shortening the anchors.
4. Continued faculty training with an emphasis on effective feedback.
5. Expanding the assessment of trainees to all levels of training and all rotations.
6. Consider different competencies to assess for different levels of training. For example, PGY 4 trainees should archive history-taking competency early in training and thus should not need assessment of these at the PGY 4 level.
7. Further studies to assess concurrent validity.

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Appendix 1: CanMEDS 2005 Physician Competency Framework

Essential Roles and Key Competencies of Physicians,

The specialist must be able to:

Medical Expert:

- function effectively as consultants, integrating all of the CanMEDS Roles to provide optimal, ethical and patient-centered medical care
- establish and maintain clinical knowledge, skills and attitudes appropriate to their practice
- perform a complete and appropriate assessment of a patient
- use preventive and therapeutic interventions effectively
- demonstrate proficient and appropriate use of procedural skills, both diagnostic and therapeutic
- seek appropriate consultation from other health professionals, recognizing the limits of their expertise

Communicator:

- develop rapport, trust and ethical therapeutic relationships with patients and families
- accurately elicit and synthesize relevant information and perspectives of patients and families, colleagues and other professionals
- accurately convey relevant information and explanations to patients and families, colleagues and other professionals
- develop a common understanding on issues, problems and plans with patients and families, colleagues and other professionals to develop a shared plan of care
- convey effective oral and written information about a medical encounter

Collaborator:

- participate effectively and appropriately in an interprofessional healthcare team
- effectively work with other health professionals to prevent, negotiate, and resolve interprofessional conflict

Manager:

- participate in activities that contribute to the effectiveness of their healthcare organizations and systems
- manage their practice and career effectively
- allocate finite healthcare resources appropriately
- serve in administration and leadership roles, as appropriate

Health Advocate:

- respond to individual patient health needs and issues as part of patient care
- respond to the health needs of the communities that they serve
- identify the determinants of health of the populations that they serve
- promote the health of individual patients, communities and populations

Scholar:

- maintain and enhance professional activities through ongoing learning
- critically evaluate information and its sources, and apply this appropriately to practice decisions
- facilitate the learning of patients, families, students, residents, other health professionals, the public, and others, as appropriate
- contribute to the creation, dissemination, application, and translation of new medical knowledge and practices

Professional:

- demonstrate a commitment to their patients, profession and society through ethical practice
- demonstrate a commitment to their patients, profession, and society through participation in profession-led regulation
- demonstrate a commitment to physician health and sustainable practice

Appendix 2: Guidelines for General Pediatric Attending, MacPeds Competency Based Medical Education

Introduction:

The McMaster Residency Program (MacPeds) has implemented a competency-based education for the PGY 1 year starting July 2013.

An integral part of the competency based education for pediatric residents is workplace-based assessment. This will require a shift in thinking for the evaluator/supervisor. The transition will require that pediatric residents are evaluated on their progressive pediatric training achievements. Assessments can best be conceptualized as a developmental spectrum whereby each milestone progresses towards the achievement of competency as a general pediatric consultant. This is in contrast our traditional evaluation tools, which denote the resident as being ranked "below, meeting or exceeding expectations" or compared to other residents. In order to assess where a resident is on their developmental milestones towards becoming a competent general pediatrician will require multiple direct observations of performance -- previously known as mini-CEX, now altered to be specific to each type of encounter and known as Mini-MAS, Mini milestones assessment.

To assist with an understanding of the appropriate timelines for achievement of developmental milestones for the outcome-based curriculum for pediatric residents, please refer to the handbook. This table may be used as a guide when completing the evaluation forms, as well as the mini-MAS assessments. An important factor to consider when completing the evaluations is that a resident in first year should not be evaluated at the highest ranking, as they should not be performing as a consultant pediatrician in the developmental trajectory of the pediatric residency.

The following guidelines should be considered when assessing the pediatric resident:

1. Residents must be observed in their various capacities in order to complete their assessment (either obtaining a history, performing a physical examination, discussing management, interacting with other health professionals etc.…). It is not necessary to observe the entire history or physical examination. An assessor can observe the resident performing various tasks throughout the rotation.

2. It is essential that the form be completed at time of observation. Delay often does not allow for meaningful feedback and with competency based medical education (CBME), it may be more difficult to demonstrate where the resident is in their continuum of development

3. Verbal Feedback is an integral component of assessment and it should be provided in addition to written evaluations in order to make it relevant for the resident and allow for a discussion about ways the resident can continue to improve.

4. Evaluators should not review the resident's previous evaluations with colleagues. Each scenario that the resident is evaluated on is unique and bias should be avoided.

5. Frequent, routine and shorter assessments are less likely to cause stress in the learner and may be easier to complete by the assessor, as they may be less time consuming.

6. Scheduling of assessments between the assessor and the resident is more likely to ensure that they occur. At the outset of the rotation, the pediatrician and resident may state which days will be set out for assessment. On the days that the assessment is to take place, the trainee and assessor should set aside a specific time.

7. The trainee should be made aware of the type of assessment that will occur (e.g. physical examination).

8. All trainees will receive a copy of the evaluation forms and Mini-MAS in advance of their general pediatric rotations.

Appendix 3: Medical Expert Content

1. The resident should have an understanding of the applied anatomy and physiology with respect to the problems and conditions found on the wards.

2. The pediatric resident should be able to:
    a. Recognize the unique natural history of pediatric diseases.
    b. Recognize limited host resistance and high risk of nosocomial infections in newborns.
    c. Recognize the need to individualize drug dosage and fluid administration on the basis of weight, and be able to calculate expediently nutritional and fluid and electrolyte requirements using standard formulas.
    d. Recognize the normal range and wide variation with respect to diagnostic tests involving infants and children of different ages.
    e. Recognize the unique needs of the complex patient with chronic conditions.
    f. Recognize adolescence as a developmental phase with unique medical and psychosocial issues.

3. Be able to diagnose and manage a variety of medical conditions including:

Pediatric:

a. Respiratory illnesses – including asthma, croup, bronchiolitis, cystic fibrosis and pneumonia.
b. Cardiac disease – including innocent and pathologic murmurs, congenital heart disease, arrhythmias, congestive heart failure and Kawasaki disease.
c. CNS disease – including seizures, headaches, acquired brain injury and specific diseases affecting development (eg. cerebral palsy).
d. Gastrointestinal diseases – including gastroenteritis and dehydration, malabsorption and constipation.
e. Infectious diseases – including all common viral and bacterial infections.

f. Dermatology – including eczema, urticaria, newborn and erythematous rashes.
g. Child neglect and maltreatment – including skeletal injuries, skin lesions, sexual abuse and shaken baby syndrome.
h. Hematology – including anemia and thrombocytopenia
i. Management of issues around the complex patient with chronic conditions.
j. Management of common endocrinology issues such as diabetes and it's complications
k. Recognize common genetic conditions such as Down syndrome and be able to recognize dysmorphic features.
l. Know the common developmental milestones and recognize developmental delay. Understand the initial steps in evaluation and management of developmental delay.

Neonatal:

a. Jaundice
b. Sepsis
c. Seizures
d. Feeding problems
e. Hypoglycemia
f. Respiratory Distress Syndrome (RDS), Transient Tachypnea of the Newborn (TTN)
g. Innocent and pathologic murmurs
h. Congenital heart disease
i. Newborn rashes
j. Anemia, thrombocytopenia

4. Demonstrate technique in performing medical procedures including:
    - lumbar puncture
    - bladder catheterization
    - Peripheral IV insertion
    - insertion of umbilical venous and arterial lines
    - insertion of naso gastric feeding tubes
    - neonatal intubation

- neonatal resuscitation
- pediatric resuscitation

Appendix 4: Suggested Timelines to Achieve Objectives

Learning Outcome:	Developmental Milestone:	Time Frame Trainee Should Achieve Stage (months)
1. Competence in clinical skills: The resident should be competent to take a comprehensive, relevant medical and social history and perform a physical examination. He or she should be able to record and interpret the findings and formulate an appropriate action plan to characterize the problem and reach a diagnosis.	History: Data Gathering	
	1. Acquire accurate and relevant history from the patient in an efficiently customized, prioritized, and hypothesis driven fashion	6
	2. Seek and obtain appropriate, verified, and prioritized data from secondary sources (eg, family, records, pharmacy)	9
	3. Obtain relevant historical subtleties that inform and prioritize both differential diagnoses and diagnostic plans, including sensitive, complicated, and detailed information that may not often be volunteered by the patient	18
	4. Role model gathering subtle and reliable information from the patient for junior members of the health care team.	30
	Performing a Physical examination	
	1. Perform an accurate physical examination that is appropriately targeted to the patient's complaints and medical conditions. Identify pertinent abnormalities using common maneuvers	6
	2. Accurately track important changes in the physical examination over time in the outpatient and inpatient settings	9
	3. Demonstrate and teach how to elicit important physical findings for junior members of the health care team	18

	Clinical Reasoning	
	1. Synthesize all available data, including interview, physical examination, and preliminary laboratory data, to define each patient's central clinical problem	12
	2. Develop prioritized differential diagnoses, evidence- based diagnostic and therapeutic plan for common inpatient and ambulatory conditions	12-18
	3. Modify differential diagnosis and care plan based on clinical course and data as appropriate	24
	4. Recognize disease presentations that deviate from common patterns and that require complex decision-making.	36
2. Competence to perform practical procedures: The resident should be able to undertake a range of procedures on a patient for diagnostic or therapeutic purposes.	Procedures:	
	1. Appropriately perform invasive procedures and provide post-procedure management for common procedures.	12-18
3. Competence to investigate a patient: The resident should be competent to arrange appropriate investigations for a patient and where appropriate interpret these.	Diagnostic Tests:	
	1. Understand indications for and basic interpretation of common diagnostic testing, including but not limited to routine blood chemistries, hematologic studies, coagulation tests, arterial blood gases, ECG, chest radiographs, pulmonary function tests, urinalysis, and other body fluids	12
	2. Make appropriate clinical decisions based on the results of common diagnostic testing, including but not limited to routine blood chemistries, hematologic studies, coagulation tests, arterial blood gases, ECG, chest radiographs, pulmonary function tests, urinalysis and other body fluids	12
	3. Understand prior probability and test performance characteristics	18
	4. Understand indications for and has basic skills in interpreting more advanced diagnostic tests	18
	5. Make appropriate clinical decision based on the results of more advanced diagnostic tests	18

4. Competence to manage a patient: The resident is competent to identify appropriate treatment for the patient and to deliver this personally or to refer the patient to the appropriate colleague for treatment. Included are interventions such as surgery and drug therapy and contexts for care such as acute care and rehabilitation.	Patient Management:	
	1. Recognize situations with a need for urgent or emergent medical care, including life-threatening conditions	6
	2. Recognize when to seek additional guidance	6
	3. Provide appropriate preventive care and teach patient regarding self-care	6
	4. With supervision, manage patients with common clinical disorders seen in the practice of inpatient and ambulatory general pediatrics	12
	5. With minimal supervision, manage patients with common and complex clinical disorders seen in the practice of inpatient and ambulatory general pediatrics	12
	6. Initiate management and stabilize patients with emergent medical conditions	12
	7. Manage patients with conditions that require intensive care	36
	8. Independently manage patients with a broad spectrum of clinical disorders seen in the practice of general pediatric medicine.	36
5. Competence in health promotion and disease prevention: The resident recognizes threats to the health of individuals or communities at risk. The resident is able to implement, prevention and health promotion. This is recognized as an important basic competence alongside the management of patients with disease.	1. Believes that population health issues impact the health of his patients and therefore proactively identifies sources of information about the needs and assets of the community in which he practices.	6
	2. Interacts and begins to work collaboratively with community agencies, professionals, and others in order to address population health issues.	12
	3. Identifies population health issues through individual clinical experiences and community interaction. Is knowledgeable about and keeps up to date with the needs and assets of the community in which he practices.	18
6. Competence in skills of communication: The resident is proficient in a range of communication skills, including written and oral, both face-to-face and by telephone. He	Communicates Effectively	
	1. Deliver appropriate, succinct, hypothesis-driven oral presentations	6
	2. Provide timely and comprehensive verbal and written communication to patients/advocates	12
	3. Effectively use verbal and nonverbal skills to create rapport with patients/families	12

or she communicates effectively with patients, relatives of patients, the public and colleagues. (7) Competence to retrieve and handle information: The resident is competent in recording, retrieving and analyzing information using a range of methods including computers	4. Use communication skills to build a therapeutic relationship	12
	5. Engage patients/advocates in shared decision making for uncomplicated diagnostic and therapeutic scenarios	18-24
	6. Effectively communicate with other caregivers in order to maintain appropriate continuity during transitions of care	12
	7. Role model and teach effective communication with next caregivers during transitions of care	18-24
	8. Request consultative services in an effective manner	6
	9. Clearly communicate the role of consultant to the patient, in support of the primary care relationship	12
	10. Provide legible, accurate, complete, and timely written communication that is congruent with medical standards	6
	11. Ensure succinct, relevant, and patient-specific written communication	24
	12. Appropriately counsel patients about the risks and benefits of tests and procedures, highlighting cost awareness and resource allocation.	36
	13. Engage patients/advocates in shared decision making for difficult, ambiguous, or controversial scenarios.	36
8. With an understanding of basic, clinical and social sciences: Residents should understand the basic, clinical and social sciences that underpin the practice of medicine. They are not only able to carry out the tasks described in outcomes 1 to 7, but do this with an understanding of what they are doing, including an awareness of the psychosocial dimensions of medicine and can justify why they are doing it i.e. `academic intelligences'	Knowledge of core content	
	1. Understand the relevant pathophysiology and basic science for common medical conditions	6
	2. Demonstrate sufficient knowledge to diagnose and treat common conditions that require hospitalization	12
	3. Demonstrate sufficient knowledge to evaluate common ambulatory conditions	18
	4. Demonstrate sufficient knowledge to diagnose and treat undifferentiated and emergent conditions	18
	5. Demonstrate sufficient knowledge to provide preventive care	18
	6. Demonstrate sufficient knowledge to evaluate complex or rare medical conditions and multiple coexistent conditions.	36

9. With appropriate attitudes, ethical understanding and understanding of legal responsibilities: Residents adopt appropriate attitudes, ethical behaviour and legal approaches to the practice of medicine. This includes issues relating to informed consent, confidentiality, and the practice of medicine in a multicultural society. The importance of emotions and feelings is recognized as the `emotional intelligences'.	Ethics	
	1. Document and report clinical information truthfully	1
	2. Follow formal policies	1
	3. Treat patients with dignity, civility and respect, regardless of race, culture, gender, ethnicity, age, or socioeconomic status	1
	4. Maintain patient confidentiality	1
	5. Demonstrate empathy and compassion to all patients	3
	6. Demonstrate a commitment to relieve pain and suffering	3
	7. Accept personal errors and honestly acknowledge them	6
	8. Recognize that disparities exist in health care among populations and that they may impact care of the patient	12
	9. Provide support (physical, psychological, social, and spiritual) for dying patients and their families.	24
	10. Uphold ethical expectations of research and scholarly activity.	36
10. With appropriate decision making skills and clinical reasoning and judgment: Residents apply clinical judgment and evidence-based medicine to their practice. They understand research and statistical methods. They can cope with uncertainty and ambiguity. Medicine requires, in some cases, instant recognition, response and unreflective action, and at other times deliberate analysis and decisions, and action	Critical Appraisal/Quality Improvement	
	1. Identify learning needs (clinical questions) as they emerge in patient care activities	12
	2. Access medical information resources to answer clinical questions and support decision making	12
	3. Effectively and efficiently search database for original clinical research articles	12
	4. With assistance, appraise study design, conduct, and statistical analysis in clinical research papers	12

following a period of refection and deliberation. This outcome also recognizes the creative element in problem solving that can be important in medical practice	5. Determine if clinical evidence can be generalized to an individual patient	12
	6. Recognize health system forces that increase the risk for error including barriers to optimal patient care	12
	7. Identify, reflect on, and learn from critical incidents such as near misses and preventable medical errors	12
	8. Perform or review audit of a panel of patients using standardized, disease-specific, and evidence-based criteria. Reflect on audit compared with local or national benchmarks and explore possible explanations for deficiencies, including doctor- related, system-related, and patient related factor	24
	9. Identify areas in resident's own practice and local system that can be changed to improve affect of the processes and outcomes of care	36
11. Appreciation of the role of the resident within the health service: Residents understand the healthcare system within which they are practicing and the roles of other professionals within the system. They appreciate the role of the resident as physician, teacher, manager, collaborator, professional and researcher. It implies a	Collaborator	
	1. Request consultative services in an effective manner	6
	2. Appreciate roles of a variety of health care providers, including but not limited to consultants, therapists, nurses, home care workers, pharmacists, and social workers.	6
	3. Work effectively as a member within the interprofessional team to ensure safe patient care.	6
	4. Consider alternative solutions provided by other teammates	12
	5. Effectively communicate plan of care to all members of the health care team	12
	6. Clearly communicate the role of consultant to the patient, in support of	12

willingness of the resident to contribute to research even in a modest way and to build up the evidence base for medical practice. It also recognizes that most residents have some management and teaching responsibility.	the primary care relationship	
	7. Communicate constructive feedback to other members of the health care team	12
	8. Recognize and manage conflict when patient values differ from their own.	30
	9. Demonstrate how to manage the team by using the skills and coordinating the activities of interprofessional team members.	36
	Manager	
	1. Identify costs for common diagnostic or therapeutic tests.	6
	2. Minimize unnecessary care including tests, procedures, therapies, and ambulatory or hospital encounters	6
	3. Reflect awareness of common socioeconomic barriers that impact patient care.	12
	4. Understand how cost-benefit analysis is applied to patient care (ie, via principles of screening tests and the development of clinical guidelines)	12
	5. Demonstrate the incorporation of cost-awareness principles into standard clinical judgments and decision making	18
	6. Demonstrate the incorporation of cost-awareness principles into complex clinical scenarios.	36
	Professional	
	1. Respond promptly and appropriately to clinical responsibilities including but not limited to calls and pages	1
	2. Dress and behave appropriately	1
	3. Maintain appropriate professional relationships with patients, families, and staff	1
	4. Carry out timely interactions with colleagues, patients, and their designated caregivers	6
	5. Ensure prompt completion of clinical, administrative, and curricular tasks	6
	6. Recognize and address personal, psychological, and physical limitations that may affect professional performance	12
	7. Recognize the scope of his/her abilities and ask for supervision and assistance appropriately	12
	8. Serve as a professional role model for more junior colleagues (eg, medical students, interns).	30

12. Aptitude for personal development: The resident has certain attributes important for the practice of medicine. He or she is a self-learner and is able to assess his or her own performance. The resident takes responsibility for his or her own personal and professional development, including personal health and career development.	Personal Development	
	1. Respond welcomingly and productively to feedback from all members of the health care team including faculty, peer residents, students, nurses, allied health workers, patients, and their advocates	12
	2. Actively participate in teaching conferences	12
	3. Actively seek feedback from all members of the health care team	18
	4. Integrate teaching, feedback, and evaluation with supervision of interns' and students' patient care	24

Appendix 5: End of Rotation Evaluation CBME

	N/A	Needs Attention	Developing	Achieving
1 The pediatric resident is able to diagnose and manage a variety of medical conditions including:	○	○	○	○
a. Respiratory illnesses – including asthma, croup, bronchiolitis, cystic fibrosis and pneumonia.	○	○	○	○
b. Cardiac disease – including innocent and pathologic murmurs, congenital heart disease, arrhythmias, congestive heart failure and Kawasaki disease.	○	○	○	○
c. CNS disease – including seizures, headaches, acquired brain injury and specific diseases affecting development, e.g. cerebral palsy.	○	○	○	○
d. Gastrointestinal diseases – including gastroenteritis and dehydration, malabsorption and constipation.	○	○	○	○
e. Infectious diseases – including all common viral and bacterial infections.	○	○	○	○
f. Dermatology – including eczema, urticaria, newborn and erythematous rashes.	○	○	○	○
g. Hematology – including anemia and thrombocytopenia.	○	○	○	○

h. Child neglect and maltreatment – including skeletal injuries, skin lesions, sexual abuse and shaken baby syndrome.				
i. Management of issues around the complex patient with chronic conditions.				
j. Management of common endocrinology issues such as diabetes and it's complications				
k. Recognize common genetic conditions such as Down syndrome and be able to recognize dysmorphic features.				
l. Know the common developmental milestones and recognize developmental delay. Understand the initial steps in evaluation and management of developmental delay.				
m. Recognize adolescence as a developmental phase with unique medical and psychosocial issues.				
Neonatal: Jaundice, Sepsis, Seizures, Feeding problems, Hypoglycemia, RDS, TTN, Innocent and pathologic murmurs, Congenital heart disease, Newborn rashes, Anemia, thrombocytopenia				

Demonstrates aseptic technique in performing medical procedures including: • lumbar puncture • bladder catheterization • Peripheral IV insertion • insertion of umbilical venous and arterial lines • insertion of naso gastric feeding tubes • neonatal intubation • neonatal resuscitation • pediatric resuscitation	○	○	○	○
History: Data Gathering				
1. Acquire accurate and relevant history from the patient in an efficiently customized, prioritized, and hypothesis driven fashion	○	○	○	○
2. Seek and obtain appropriate, verified, and prioritized data from secondary sources (eg, family, records, pharmacy)	○	○	○	○
Performing a Physical examination	○	○	○	○
1. Perform an accurate physical examination that is appropriately targeted to the patient's complaints and medical conditions. Identify pertinent abnormalities using common maneuvers	○	○	○	○
2. Accurately track important changes in the physical examination over time in the outpatient and inpatient settings	○	○	○	○
Clinical Reasoning				
1. Synthesize all available data, including interview, physical examination, and preliminary laboratory data, to define each patient's central clinical problem	○	○	○	○

2. Develop prioritized differential diagnoses, evidence- based diagnostic and therapeutic plan for common inpatient and ambulatory conditions	○	○	○	○
Procedures:				
1. Appropriately perform invasive procedures and provide post-procedure management for common procedures.	○	○	○	○
Diagnostic Tests:				
1. Understand indications for and basic interpretation of common diagnostic testing, including but not limited to routine blood chemistries, hematologic studies, coagulation tests, arterial blood gases, ECG, chest radiographs, pulmonary function tests, urinalysis, and other body fluids	○	○	○	○
2. Make appropriate clinical decisions based on the results of common diagnostic testing, including but not limited to routine blood chemistries, hematologic studies, coagulation tests, arterial blood gases, ECG, chest radiographs, pulmonary function tests, urinalysis and other body fluids	○	○	○	○
Patient Management:				
1. Recognize situations with a need for urgent or emergent medical care, including life-threatening conditions	○	○	○	○
2. Recognize when to seek additional guidance	○	○	○	○
3. Provide appropriate preventive care and teach patient regarding self-care	○	○	○	○
4. With supervision, manage patients with common clinical disorders seen in the practice of inpatient and ambulatory general pediatrics	○	○	○	○

5. With minimal supervision, manage patients with common and complex clinical disorders seen in the practice of inpatient and ambulatory general pediatrics	○	○	○	○
6. Initiate management and stabilize patients with emergent medical conditions	○	○	○	○
4. Believes that population health issues impact the health of his patients and therefore proactively identifies sources of information about the needs and assets of the community in which he practices.	○	○	○	○
5. Interacts and begins to work collaboratively with community agencies, professionals, and others in order to address population health issues.	○	○	○	○
Communicates Effectively				
1. Deliver appropriate, succinct, hypothesis-driven oral presentations	○	○	○	○
2. Provide timely and comprehensive verbal and written communication to patients/advocates	○	○	○	○
3. Effectively use verbal and nonverbal skills to create rapport with patients/families	○	○	○	○
4. Use communication skills to build a therapeutic relationship	○	○	○	○
5. Effectively communicate with other caregivers in order to maintain appropriate continuity during transitions of care	○	○	○	○
6. Request consultative services in an effective manner	○	○	○	○
7. Clearly communicate the role of consultant to the patient, in support of the primary care relationship	○	○	○	○

8. Provide legible, accurate, complete, and timely written communication that is congruent with medical standards				
Knowledge of core content				
1. Understand the relevant pathophysiology and basic science for common medical conditions				
2. Demonstrate sufficient knowledge to diagnose and treat common conditions that require hospitalization				
Ethics				
1. Document and report clinical information truthfully				
2. Follow formal policies				
3. Treat patients with dignity, civility and respect, regardless of race, culture, gender, ethnicity, age, or socioeconomic status				
4. Maintain patient confidentiality				
5. Demonstrate empathy and compassion to all patients				
6. Demonstrate a commitment to relieve pain and suffering				
7. Accept personal errors and honestly acknowledge them				
8. Recognize that disparities exist in health care among populations and that they may impact care of the patient				

Critical Appraisal/Quality Improvement				
1. Identify learning needs (clinical questions) as they emerge in patient care activities	○	○	○	○
2. Access medical information resources to answer clinical questions and support decision making	○	○	○	○
3. Effectively and efficiently search database for original clinical research articles	○	○	○	○
4. With assistance, appraise study design, conduct, and statistical analysis in clinical research papers	○	○	○	○
5. Determine if clinical evidence can be generalized to an individual patient	○	○	○	○
6. Recognize health system forces that increase the risk for error including barriers to optimal patient care	○	○	○	○
7. Identify, reflect on, and learn from critical incidents such as near misses and preventable medical errors	○	○	○	○
Collaborator				
1. Request consultative services in an effective manner	○	○	○	○
2. Appreciate roles of a variety of health care providers, including but not limited to consultants, therapists, nurses, home care workers, pharmacists, and social workers.	○	○	○	○
3. Work effectively as a member within the interprofessional team to ensure safe patient care.	○	○	○	○
4. Consider alternative solutions provided by other teammates	○	○	○	○
5. Effectively communicate plan of care to all members of the health care team	○	○	○	○

6. Clearly communicate the role of consultant to the patient, in support of the primary care relationship				
7. Communicate constructive feedback to other members of the health care team				
Manager				
1. Identify costs for common diagnostic or therapeutic tests.				
2. Minimize unnecessary care including tests, procedures, therapies, and ambulatory or hospital encounters				
3. Reflect awareness of common socioeconomic barriers that impact patient care.				
4. Understand how cost-benefit analysis is applied to patient care (i.e., via principles of screening tests and the development of clinical guidelines)				
Professional				
1. Respond promptly and appropriately to clinical responsibilities including but not limited to calls and pages				
2. Dress and behave appropriately				
3. Maintain appropriate professional relationships with patients, families, and staff				
4. Carry out timely interactions with colleagues, patients, and their designated caregivers				
5. Ensure prompt completion of clinical, administrative, and curricular tasks				
6. Recognize and address personal, psychological, and physical limitations that may affect professional performance				

7. Recognize the scope of his/her abilities and ask for supervision and assistance appropriately	○	○	○	○
Personal Development				
1. Respond welcomingly and productively to feedback from all members of the health care team including faculty, peer residents, students, nurses, allied health workers, patients, and their advocates	○	○	○	○
2. Actively participate in teaching conferences	○	○	○	○

Appendix 6: The Mini-MAS TOOL

MacPeds Mini MAS for Competency Based Medicine

Resident: _____ **Evaluator:** _____

Date: _____ **Rotation/Setting:**_____**Patient Problem:** _____

Please base this rating on your observation for this encounter not other scores

Developmental Milestones: Data Gathering		
Novice	**Check One Box**	
▲		❖ Either gathers too little information or exhaustively gathers information following a Template regardless of the patient's chief complaint, with each piece of information gathered seeming as important as the next. Recalls clinical information in the order elicited, with the ability to gather, filter, prioritize and connect pieces of information being limited by and dependent upon analytic reasoning through basic pathophysiology alone.
		❖ Clinical experience allows linkage of signs and symptoms of a current patient to those encountered in previous patients. Still relies primarily on analytic reasoning through basic pathophysiology to gather information, but the ability to link current findings to prior clinical encounters allows information to be filtered, prioritized and synthesized into pertinent positives and negatives as well as broad diagnostic categories.
		❖ Advanced development of pattern recognition leads to the creation of illness scripts, which allow information to be gathered while it is simultaneously filtered, prioritized and synthesized into specific diagnostic considerations. Data gathering is driven by real-time development of a differential diagnosis early in the information-gathering process.
		❖ Well-developed illness scripts allow essential and accurate information to be gathered and precise diagnoses to be reached with ease and efficiency when presented with most pediatric problems, but still relies on analytic reasoning through basic pathophysiology to gather information when presented with complex or uncommon problems.
▼		❖ Robust illness scripts and instance scripts (where the specific features of individual patients are remembered and used in future clinical reasoning) lead to unconscious gathering of essential and accurate information in a targeted and efficient manner when presented with all but the most complex problems. These illness and instance scripts are robust enough to enable discrimination among diagnoses with subtle distinguishing features.
Expert		
Adapted from The American Board of Pediatrics: The Pediatrics Milestone Project		

Please circle: Please base this rating on your observation for this encounter not other scores

1. Has this resident demonstrated professional behaviour?

YES **NO**

If **No** explain: _____

2. Comment Box: _____

Evaluator Satisfaction with Mini-MAS:

Low 1 2 3 4 5 6 7 8 9 High

Evaluator Signature: _____**Resident Signature:** _____

MacPeds Mini MAS for Competency Based Medicine

Resident: _____ **Evaluator:** _____

Date: _____ **Rotation/Setting:**_____**Patient Problem:** _____

Developmental Milestones: Performing of the Physical Examination		
Novice	**Check One Box**	
↕		❖ Performs and elicits most physical examination maneuvers **incorrectly. Does not alter the head-to-toe approach** to the physical examination to meet a child's developmental level or behavioral needs.
		❖ **Performs basic physical examination maneuvers** correctly (e.g., auscultation of the lung fields) but does not regularly elicit, recognize, or interpret abnormal findings (ex: recognition of wheezing and crackles). **Sometimes uses a developmentally appropriate approach** to the physical examination, achieving variable success
		❖ **Performs basic physical examination maneuvers** correctly and **recognizes** and correctly interprets **abnormal findings Consistently and successfully uses a developmentally appropriate approach** when examining children.
		❖ Performs, elicits, recognizes, and interprets the findings of **most physical Examination maneuvers** correctly. Performs, elicits, recognizes, and interprets the findings of even **special testing physical examination maneuvers** correctly most of the time
		❖ Is fluid and agile in performing the physical examination in a way that **maximizes cooperation of the child** and thus accuracy of findings; experience facilitates the engagement of the child **as well as the caregiver** in the physical examination.
Expert		
Adapted from The American Board of Pediatrics: The Pediatrics Milestone Project		

Please base this rating on your observation for this encounter not other scores

Please circle

1. Has this resident demonstrated professional behaviour?

YES **NO**

If **No** explain: _____

2. Comment Box: _____

Evaluator Satisfaction with Mini-MAS:

Low 1 2 3 4 5 6 7 8 9 High

Evaluator Signature: _____**Resident Signature:** _____

MacPeds Mini MAS for Competency Based Medicine

Resident: _____ **Evaluator:** _____

Date: _____ **Rotation/Setting:**_____**Patient Problem:** _____

Developmental Milestone: Clinical Reasoning		
Novice	**Check One Box**	
↑		❖ Develops and carries out management plans based on directives from others, either from the health care organization or the supervising physician. Unable to adjust plans based on individual patient differences or preferences. Communication about the plan is unidirectional from the practitioner to the patient and family.
		❖ Develops and carries out management plans based on one's theoretical knowledge and/or directives from others. Can adapt plans to the individual patient, but only within the framework of one's own theoretical knowledge. Unable to focus on key information, so conclusions are often from arbitrary, poorly prioritized, and time-limited information gathering. Management plans based on the framework of one's own, assumptions and values.
		❖ Develops and carries out management plans based on both theoretical knowledge and some experience, especially in managing common problems. Follows health care institution directives as a matter of habit and good practice rather than as an externally imposed sanction. Able to more effectively and efficiently focus on key information, but still may be limited by time and convenience. Plans begin to incorporate patients' assumptions and values through more bidirectional communication.
		❖ Develops and carries out management plans based most often on experience. Effectively and efficiently focuses on key information. To arrive at a plan. Incorporates patients' assumptions and values through bidirectional communication with little interference from personal biases.
		❖ Develops and carries out management plans, even for complicated or rare situations, based primarily on experience that puts theoretical knowledge into context. Rapidly focuses on key information to arrive at the plan and augments that with available information or seeks new information as needed. Has insight into one's own assumptions and values that allow one to filter them out and focus on the patient/family values in a bidirectional conversation about the management plan.
↓		
Expert		
Adapted from The American Board of Pediatrics: The Pediatrics Milestone Project		

Please base this rating on your observation for this encounter not other scores

Please circle

1. Has this resident demonstrated professional behaviour?

YES **NO**

If **No** explain: _____

2. Comment Box: _____

Evaluator Satisfaction with Mini-MAS:

Low 1 2 3 4 5 6 7 8 9 High

Evaluator Signature: _____**Resident Signature:** _____

MacPeds Mini MAS for Competency Based Medicine

Resident: _____ **Evaluator:** _____

Date: _____ **Rotation/Setting:**_____**Patient Problem:** _____

Developmental Milestone: Communication Skills - Communication with families		
Novice	**Check One Box**	
↕		❖ Uses standard medical interview template to prompt all questions. Does not vary the approach based on a patient's unique physical, cultural, socioeconomic, or situational needs. May feel intimidated or uncomfortable asking personal questions of patients.
		❖ Uses the medical interview to establish rapport and focus on information exchange relevant to a patient's or family's primary concerns. Identifies physical, cultural, psychological, and social barriers to communication, but often has difficulty managing them. Begins to use nonjudgmental questioning scripts in response to sensitive situations.
		❖ Uses the interview to effectively establish rapport. Able to mitigate physical, cultural, psychological, and social barriers in most situations. Verbal and nonverbal communication skills promote trust, respect, and understanding. Develops scripts to approach most difficult communication scenarios.
		❖ Uses communication to establish and maintain a therapeutic alliance. Sees beyond stereotypes and works to tailor communication to the individual. A wealth of experience has led to development of scripts for the gamut of difficult communication scenarios. Able to adjust scripts ad hoc for specific encounters.
		❖ Connects with patients and families in an authentic manner that fosters a trusting and loyal relationship. Effectively educates patients, families, and the public as part of all communication. Intuitively handles the gamut of difficult communication scenarios with grace and humility.
Expert		
Adapted from The American Board of Pediatrics: The Pediatrics Milestone Project		

Please base this rating on your observation for this encounter not other scores

Please circle:

1. Has this resident demonstrated professional behaviour?

YES **NO**

If **No** explain: _____

2. Comment Box: _____

Evaluator Satisfaction with Mini-MAS:

Low 1 2 3 4 5 6 7 8 9 High

Evaluator Signature: _____**Resident Signature:** _____

MacPeds Mini MAS for Competency Based Medicine

Resident: _____ **Evaluator:** _____

Date: _____ **Rotation/Setting:**_____**Patient Problem:** _____

Developmental Milestone: Communication with physicians & other health professionals		
Novice	**Check One Box**	
↕		❖ Rigid rules-based recitation of facts. Often communicates from a template or prompt. Communication does not change based on context, audience, or situation. Not aware of the social purpose of the communication.
		❖ Begins to understand the purpose of the communication and at times adjusts length to context, as appropriate. However, will often still err on the side of inclusion of excess details.
		❖ Successfully tailors communication strategy and message to the audience, purpose, and context in most situations. Fully aware of the purpose of the communication; can efficiently tell a story and effectively make an argument. Beginning to improvise in unfamiliar situations.
		❖ Uses the appropriate strategy for communication. Distills complex cases into succinct summaries tailored to audience, purpose, and context. Can improvise and has expanded strategies for dealing with difficult communication scenarios (e.g. an inter-professional conflict).
		❖ Master of improvisation on any new or difficult communication scenario. Recognized as a highly effective public speaker. Intuitively develops strategies for tailoring message to context to gain maximum effect. Is sought out as a role model for difficult conversations and mediator of disagreement.
Expert		
Adapted from The American Board of Pediatrics: The Pediatrics Milestone Project		

Please base this rating on your observation for this encounter not other scores

Please circle

1. Has this resident demonstrated professional behaviour?

YES **NO**

If **No** explain: _____

2. Comment Box: _____

Evaluator Satisfaction with Mini-MAS:

Low 1 2 3 4 5 6 7 8 9 High

Evaluator Signature: _____**Resident Signature:** _____

MacPeds Mini MAS for Competency Based Medicine

Resident: _____ **Evaluator:** _____

Date: _____ **Rotation/Setting:**_____**Patient Problem:** _____

Developmental Milestone: Collaborator		
Novice	**Check One Box**	
		❖ Limited participation in team discussion; passively follows the lead of others on the team. Little initiative to interact with team members. More self-centered in approach to work with a focus on one's own performance. Little awareness of one's own needs and abilities. Limited acknowledgment of the contributions of others.
		❖ Demonstrates an understanding of the roles of various team members by interacting with appropriate team members to accomplish assignments. Actively works to integrate herself into team function and meet or exceed the expectations of her given role. In general, works towards achieving team goals, but may put personal goals related to professional identity development (e.g., recognition) above pursuit of team goals.
		❖ Identifies herself and is seen by others as an integral part of the team. Seeks to learn the individual capabilities of each fellow team member and will offer coaching and performance improvement as needed. Will adapt and shift roles and responsibilities as needed to adjust to changes to achieve team goals. Communication is bi-directional with verification of understanding of the message sent and the message received in all cases.
		❖ Initiates problem-solving, frequently provides feedback to other team members, and takes personal responsibility for the outcomes of the team's work. Actively seeks feedback and initiates adaptations to help the team function more effectively in changing environments. Engages in closed loop communication in all cases to ensure that the correct message is understood by all. Seeks out and takes on leadership roles in areas of expertise and makes sure the job gets done.
		❖ Goals of the team supersede any personal goals, resulting in the ability to seamlessly assume the role of leader or follower, as needed. Creates a high-functioning team de novo or joins a poorly functioning team and facilitates improvement, such that team goals are met.
Expert		
Adapted from The American Board of Pediatrics: The Pediatrics Milestone Project		

Please base this rating on your observation for this encounter not other scores

Please circle

1. Has this resident demonstrated professional behaviour?

YES **NO**

If **No** explain: _____

2. Comment Box: _____

Evaluator Satisfaction with Mini-MAS:

Low 1 2 3 4 5 6 7 8 9 High

Evaluator Signature: _____**Resident Signature:** _____

Appendix 7: The mini-CEX: Mini Clinical Evaluation Exercise

Resident: _____ Faculty: _____ Date: _____ Setting: _____

Please circle the following:

Complexity of clinical case: Low Moderate High

Focus: Data Gathering Physical Examination Counseling

Please circle a number only under skills observed:

1. Medical Interviewing
   1 2 3 4 5 6 7 8 9
   UNSATISFACTORY SATISFACTORY SUPERIOR

2. Physical Examination Skills
   1 2 3 4 5 6 7 8 9
   UNSATISFACTORY SATISFACTORY SUPERIOR

3. Humanistic Qualities/Professionalism
   1 2 3 4 5 6 7 8 9
   UNSATISFACTORY SATISFACTORY SUPERIOR

4. Clinical Judgment
   1 2 3 4 5 6 7 8 9
   UNSATISFACTORY SATISFACTORY SUPERIOR

5. Counseling Skills
   1 2 3 4 5 6 7 8 9
   UNSATISFACTORY SATISFACTORY SUPERIOR

6. Organization/Efficiency
   1 2 3 4 5 6 7 8 9
   UNSATISFACTORY SATISFACTORY SUPERIOR

7. Overall Clinical Competence
   1 2 3 4 5 6 7 8 9
   UNSATISFACTORY SATISFACTORY SUPERIOR

Appendix 8: Resident and Assessors Survey

Resident:

Evaluation

*
Level of training at time of MINI-MAS evaluation process:
Choose one of the following answers

- ○ PGY1
- ○ PGY4

Please indicate your level of agreement with the following statements:

	Strongly Disgree	Disagree	Somewhat Disagree		Somewhat Agree	Agree	Strongly Agree	No answer
I was satisfied with the Mini-MAS as an assessment tool.	○	○	○	○	○	○	○	◉
The faculty were agreeable to observing and assessing me using the Mini-MAS tool.	○	○	○	○	○	○	○	◉
Remembering to request a Mini-MAS assessment was easy.	○	○	○	○	○	○	○	◉
I generally remembered to request an assessment prior to the patient encounter.	○	○	○	○	○	○	○	◉
The Mini-MAS was filled out soon after the observed encounter.	○	○	○	○	○	○	○	◉
I received verbal feedback after the observed encounter.	○	○	○	○	○	○	○	◉

	Strongly Disagree	Disagree	Somewhat Disagree		Somewhat Agree	Agree	Strongly Agree	No answer
The Mini-MAS tool increased the frequency of observation of my clinical performance.	○	○	○	○	○	○	○	◉
The Mini-MAS tool positively influenced my learning.	○	○	○	○	○	○	○	◉
We should continue using the Mini-MAS in our program.	○	○	○	○	○	○	○	◉

Please add any comments you wish to make regarding the Mini-MAS process.

Submit

Assessor:

Where did you complete the assessments for the majority of learners
Choose one of the following answers

- ○ Hamilton (McMaster, St. Joseph's)
- ○ Brampton
- ○ Kitchener-Waterloo (Grand River)
- ◉ No answer

Please indicate your level of agreement with the following statements:

	Strongly Disagree	Disagree	Somewhat Disagree		Somewhat Agree	Agree	Strongly Agree	No answer
I was satisfied with the Mini-MAS as an assessment tool.	○	○	○	○	○	○	○	◉
I was engaged in observing and assessing junior residents using the Mini-MAS tool.	○	○	○	○	○	○	○	◉
I was generally asked to observe and assess prior to a patient encounter.	○	○	○	○	○	○	○	◉
The Mini-MAS was ALWAYS filed out soon after the observed encounter.	○	○	○	○	○	○	○	◉
I ALWAYS provided verbal feedback after the Mini-MAS exercise.	○	○	○	○	○	○	○	◉
I feel the feedback provided will help the residents in their day-to-day clinical care.	○	○	○	○	○	○	○	◉
The Mini-MAS tool helped increase my frequency of observation of junior residents.	○	○	○	○	○	○	○	◉
THe Mini-MAS assessment increased my workload.	○	○	○	○	○	○	○	◉
I feel I need more training on the purpose of the Mini-MAS tool.	○	○	○	○	○	○	○	◉
I feel I need more training on the use of the Mini-MAS tool.	○	○	○	○	○	○	○	◉
I would like more training on providing constructive feedback.	○	○	○	○	○	○	○	◉
We should continue using the Mini-MAS in our program.	○	○	○	○	○	○	○	◉

Additional comments as an evaluator: