of indeterminate test results, representing a more appropriate approach in the light of evidence-based medical diagnosis and decision making.

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Author Contributions: Dr Foppa had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Foppa, Schneider de Araujo, Macari, Reichert, and Goldim. Acquisition of data: Schneider de Araujo, Macari, and Reichert. Analysis and interpretation of data: Foppa. Drafting of the manuscript: Foppa. Critical revision of the manuscript for important intellectual content: Schneider de Araujo, Macari, Reichert, and Goldim. Statistical analysis: Foppa. Obtained funding: Foppa. Administrative, technical, and material support: Schneider de Araujo, Macari, and Reichert. Study supervision: Foppa and Goldim.

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Methods. A cohort was assembled comprising all physicians who took the national clinical skills licensing examination (Medical Council of Canada: Qualifying Examination Part II) between 1993 and 1996. For each physician, we used linked longitudinal patient histories from prescription and health services administrative data to assemble a dynamic cohort of all patients aged 5 to 60 years with a diagnosis of asthma between 1993 and 2003. We focused our analysis on patients whose asthma was out of control at the time of the first visit to study physicians in outpatient settings, based on excess use (>250 doses) of fast-acting β-agonists (fenoterol, terbutaline, and salbutamol) in the past 3 months.

Asthma is a serious public health problem, and suboptimal asthma management has been identified as an important cause of asthma morbidity.

Effective management of asthma requires mastery of a number of interrelated physician skills. There is an increasing effort to directly teach these skills, particularly collaborative communication with patients, in medical school and specialty training programs. In 1993, Canada was the first country to require successful demonstration of clinical and communication skills on national medical licensure examination. The United States enacted the same requirement in 2005.

Our objective was to determine whether higher scores in medical knowledge and clinical and communication skills would be associated with the quality and outcomes of management for patients with poorly controlled asthma in the first 1 to 8 years in practice, after adjusting for differences in patient, physician, and practice characteristics.

Stastical analysis: Foppa. Obtained funding: Foppa. Administrative, technical, and material support: Schneider de Araujo, Macari, and Reichert. Study supervision: Foppa and Goldim.

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Association Between Physician Competence at Licensure and the Quality of Asthma Management Among Patients With Out-of-Control Asthma

Asthma is a serious public health problem, and suboptimal asthma management has been identified as an important cause of asthma morbidity. Physicians play a pivotal role in establishing asthma control, but there is considerable variation among physicians in their approach to asthma management that does not appear to be explained by differences in patient populations.

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We used the generalized estimation equation extension of multivariable logistic regression for correlated data with an autoregressive first-order AR(1) correlation structure. Patients were the unit of analysis and were clustered within study physicians. In addition to physician characteristics (physician sex, specialty, examination scores), we adjusted for practice characteristics (practice workload and practice population profile) and patient characteristics (age/sex, socioeconomic status, number of visits to study physicians). Examination scores were standardized to have SD = 100, and the adjusted change in odds of a given outcome was estimated per 1 SD in the respective score.

Results. From 1993 to 2003, a total of 90,078 patients with asthma received care from 609 study physicians in an outpatient setting for respiratory-related conditions. Of these, 3981 patients (4.4%) had out-of-control asthma at the first respiratory-related visit to study physicians, and 1960 patients (2.2%) were prescribed asthma medication by the study physician at the visit.

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During the 6-month follow-up, 380 (9.6%) of the 3981 patients with out-of-control asthma made multiple ED visits. The physicians of multiple ED users were more likely to be general practitioners and to have a lower practice volume. Of 1960 patients with out-of-control asthma who were prescribed any asthma medication by the study physician at the index visit, 1361 patients (69.4%) were prescribed an ICS. Female physicians and respiratory specialists were more likely to prescribe an ICS.

After adjusting for patient and physician characteristics, higher communication scores were associated with a significantly lower risk of multiple ED visits; a reduction in risk of 10% per 1-SD increase in score (odds ratio, 0.90; 95% confidence interval, 0.81-1.00). Higher medical knowledge, clinical decision making, and communication examination scores were all significantly associated with the increased likelihood of prescribing ICS (approximately a 4%-7% increase per 1-SD increase in each score) (Table).

**Table.** Predicted Likelihood of Outcomes Based on Multivariable Logistic Regressions

<table>
<thead>
<tr>
<th>Quality of Asthma Management</th>
<th>Quality of Asthma Prescribing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Respiratory-Related ED Visits (n = 3981 [4.4%])</td>
<td>ICS Use (n = 1960 [2.2%])</td>
</tr>
<tr>
<td>Score-Specific Adjusted OR (95% CI)a</td>
<td>Score-Specific Adjusted OR (95% CI)b</td>
</tr>
<tr>
<td>QE1 Total Score</td>
<td>QE2 Total Score</td>
</tr>
</tbody>
</table>

### MD Characteristics
- **Examination score (OR per 1-SD increase)**
  - QE1 Total Score: 0.99 (0.87-1.12)
  - QE2 Total Score: 0.97 (0.86-1.09)
  - QE2 Communication: 0.90 (0.82-1.00)
- **Female MD**
  - QE1 Total Score: 1.07 (0.86-1.32)
  - QE2 Total Score: 1.07 (0.86-1.32)
  - QE2 Communication: 1.10 (0.89-1.36)
- **Specialty**
  - Respiratory specialists: 0.78 (0.54-1.11)
  - General practitioners: 0.77 (0.54-1.10)

### Patient Characteristics
- **Female sex**
  - QE1 Total Score: 1.01 (0.86-1.18)
  - QE2 Total Score: 1.01 (0.86-1.18)
  - QE2 Communication: 1.01 (0.86-1.18)
- **Age, y**
  - >45: 1.56 (1.30-1.87)
  - ≤45: 1.56 (1.39-1.86)
- **Socioeconomic status**
  - High: 0.93 (0.55-1.12)
  - Low: 0.93 (0.78-1.12)
- **No. of follow-up visits**
  - Any: 1.20 (1.03-1.40)
  - None: 1.20 (1.03-1.40)
- **Previous ED visits**
  - Yes: 5.88 (4.89-7.08)
  - No: 5.89 (4.89-7.06)

### MD Practice Characteristics
- **Practice volume (OR per 100-visit increase)**
  - QE1 Total Score: 1.03 (0.92-1.14)
  - QE2 Total Score: 1.03 (0.92-1.14)
  - QE2 Communication: 1.01 (0.91-1.12)
- **Practice days (OR per 100-day increase)**
  - QE1 Total Score: 0.88 (0.66-1.19)
  - QE2 Total Score: 0.89 (0.66-1.19)
  - QE2 Communication: 0.89 (0.67-1.19)
- **% Of elderly patients (OR per 10% increase)**
  - QE1 Total Score: 0.97 (0.88-1.06)
  - QE2 Total Score: 0.96 (0.88-1.06)
  - QE2 Communication: 0.96 (0.88-1.05)
- **% Of female patients (OR per 10% increase)**
  - QE1 Total Score: 1.14 (1.00-1.32)
  - QE2 Total Score: 1.15 (1.00-1.32)
  - QE2 Communication: 1.16 (1.01-1.32)

Abbreviations: CI, confidence interval; ED, emergency department; ICS, inhaled corticosteroid; MD, doctor of medicine; OR, odds ratio; QE1, Qualifying Examination Part I; QE2, Qualifying Examination Part II.

a Each of the examination scores was included in the model separately and was adjusted simultaneously for MD, patient, and practices characteristics.
bPrevious ED visits were included in the analysis of quality of asthma management only.

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**Comment.** Our study demonstrates that physicians with better knowledge, clinical skills, and communication ability engage in more appropriate asthma prescribing and their patients with out-of-control asthma have fewer subsequent multiple ED visits. Our results are consistent with previous studies that have supported the predictive validity of licensing examinations by demonstrating the association between higher scores and the ability to make appropriate diagnostic and treatment decisions.7,8

Moreover, our study suggests that each domain of asthma management is potentially related to a different
component of clinical competence. As most medical schools use objective structured clinical examinations to assess performance during training, earlier remediation of suboptimal level of performance could ultimately improve the quality of asthma management in practice. Because these skills sets are required to manage other chronic conditions, the establishment of minimum performance benchmarks during training could have an overall positive effect on the quality of chronic disease management.

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Smartphones in Clinical Practice, Medical Education, and Research

Cellular phone technology and additional hardware were integrated into personal digital assistants and they evolved into smartphones. The installation of high-speed cellular networks with near-universal coverage has allowed these devices to show their full potential, which also benefits users in the medical community. Long-term Evolution technology (LTE), the high end of the fourth generation (4G) of mobile networks, offers speeds up to a hundred times faster than 3G. Currently, 64% of US physicians own smartphones, but this is predicted to increase to 81% penetration by 2012.

Anatomy and Physiology of Smartphones. Hardware. Today’s high-end smartphones feature capacitive (finger gesture enabled) or noncapacitive (stylus enabled) high-resolution touch screens, discrete or screen keypads, communication ports such as mini-USB, infrared, Bluetooth, wireless local area network radios, assisted global positioning technology, electronic compasses, accelerometers, gyroscopes, proximity and ambient light sensors, microphones and cameras for videoconferencing, and inductive, cable-free battery charge technology.

Software. The most critical aspect of any computer is the software it is running, since it ultimately determines usability, usefulness, and user adoption (see eTables 1 and 2 and eFigures 1-3; http://www.archinternmed.com). Other important aspects include multitasking, adherence to industry standards, and availability of native software applications (Figure and eFigure 2) vs simple mobile Web pages (Web apps) (Figure and eTable 1).

Smartphone Applications. Clinical Practice. Most health care professionals desire current clinical information and decision support at the point of care. Smartphones can provide both by accessing traditional medical textbooks, professional society guidelines, drug references, and institution-specific therapy standards. Medical calculators simplify the bedside use of medical equations, scores, stratification, and risk prediction and prevention models. Smartphones can assist with physical examinations using applications to check hearing, eye-sight, and color recognition; evaluate mental status; or photograph or video document physical findings.

Taking full advantage of current technology means wireless retrieving of the most up-to-date information anywhere anytime. The National Library of Medicine’s “PubMed for handhelds” engine and third-party applications offer searches structured by diseases and conditions, medical specialties, differential diagnosis, drugs and medications, and journals and medical news or use a latent semantic analysis framework.

Our patients expect information about their condition, the treatments, and procedures we offer them. Illustrations and videos formatted for mobile display can