SUMMARY

Aim: The aim of the study was to assess the efficacy of pegylated interferon (Peg-IFN) α-2a and ribavirin (RBV) combination therapy in treatment-naive patients with chronic hepatitis C in Estonia.

Methods: Out of 121 outpatients with chronic hepatitis C (73 males, 48 females, aged 19−63) enrolled in the study, 76 were infected with HCV genotype 1b and 45 with genotype 3a. At baseline, the viral load in 75.2% of patients was higher than 600,000 IU/mL. Histologically, 88.4% of patients had fibrosis score F0−2. Patients received 180 μg of Peg-IFN α-2a weekly plus daily ribavirin 1,000 or 1,200 mg, depending on body weight, in HCV genotype 1b, or 800 mg/day in genotype 3a infection.

Results: The overall sustained virologic response (SVR) rate in our study was 60.3%, being statistically lower for patients with HCV genotype 1b as compared to patients with genotype 3a (46.1% vs. 84.4%, p<0.05). The non-response and relapse rates were significantly higher in patients infected with HCV genotype 1b compared with patients infected with genotype 3a (19.7% vs. 2.2%, p=0.01; and 17.1% vs. 4.4%, p=0.04; respectively).

The SVR rate was higher in patients younger than 40 years compared with older patients (76.4% vs. 47.0%, p<0.01), regardless of the genotype. Thirteen patients infected with HCV genotype 1b required dose reduction of PegIFN and/or RBV because of adverse side effects. Nine of them achieved SVR.

Conclusion: HCV genotype and age younger than 40 years predetermined SVR rate in treatment-naive Estonian patients with chronic hepatitis C treated with Peg-IFN α-2a plus ribavirin.

Key words: chronic hepatitis C, genotypes, pegylated interferon, ribavirin, sustained virologic response, viral load

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INTRODUCTION

Hepatitis C virus (HCV) is a leading cause of chronic liver disease, end-stage cirrhosis, and liver cancer worldwide (1). As a result, long-term care and liver transplantation are needed, which consequently imposes a significant burden on the health care system.

The estimated global prevalence of HCV infection is around 3%, corresponding to 170 million infected people (2, 3). In different European countries the prevalence of HCV ranges between 0.1 and 5% (4, 5). According to an educated guess, up to 1% of 1.34 mln of Estonian inhabitants are infected with HCV, and this virus was reported as the main aetiologic agent for chronic hepatitis in Estonian patients (6, 7).

Several risk factors for HCV infection are well established. In Estonia, HCV transmission via medical interventions including transfusion of blood and blood products and surgery has declined significantly since the mid 1990s. From 1996 up today, injection drug use (IDU) has become the most common mode of infection (6, 7). However, for 50–60% of all notified HCV cases the source of infection remains unknown.

There is no vaccine and no post-exposure prophylaxis for HCV. The current standard of care for patients with chronic hepatitis C (CHC) is based on combination treatment with pegylated interferon-alpha plus ribavirin (Peg-IFNα/RBV) administered for 24 or 48 weeks depending on the viral genotype (8). The primary goal of antiviral treatment for chronic hepatitis C is a long-lasting HCV eradication.

In Estonia, treatment principles of chronic hepatitis C were introduced in 2001. Nowadays, the enrolment of patients and their further treatment are conducted according to the National Guidelines on the combined treatment of CHC with Peg-IFNα/RBV, which were approved by the Estonian Society of Gastroenterology and the Estonian Society for Infectious Diseases in 2006 and updated in 2007 and 2010. Annually, around 400 patients with CHC receive combined antiviral treatment.
The criterion for evaluation of therapy efficacy is sustained virological response (SVR), defined as serum HCV RNA undetectable by a sensitive molecular assay at week 24 after the end of therapy (9). When patients achieve SVR the risk of virological relapse is very low (10).

Both viral and host factors appear to be important in the virological response to combination therapy (11, 12).

The HCV has been classified into 6 major genotypes and a number of subtypes (13). HCV genotypes have a geographically distinct distribution (14). In Estonia, subtypes 1b and 3a are predominating alike in other East European countries (15).

The HCV genotype has emerged as an important factor both in predicting SVR and in determining the duration of antiviral therapy with genotype 1 infections having the lowest response rates and requiring the longest therapy (16–19). High viral load, male gender, advanced fibrosis/cirrhosis and older age are the factors associated with a less favourable response to antiviral therapy (20, 21).

The aim of our study was to evaluate the efficacy of peginterferon alpha-2a and ribavirin therapy depending on HCV genotype, baseline viral load, fibrosis stage, age and gender in treatment-naive Estonian patients with chronic hepatitis C.

To our knowledge, this is the first systematic study to assess the factors predicting the outcome of Peg-IFNα/RBV combination treatment in patients with chronic hepatitis C in clinical practice in Estonia.

**MATERIALS AND METHODS**

**Patients**

From February 2005 to September 2010, a total of 121 treatment-naive patients with chronic hepatitis C visiting the Outpatient Clinic of West-Tallinn Central Hospital were enrolled in our prospective clinical study.

The diagnosis of CHC was based on presence of anti-HCV antibodies in the sera, detection of serum HCV RNA, histologically verified fibrosis stage and clinical follow-up.

The exclusion criteria were age <18 and >63 years, chronic alcohol intake, decompensated cirrhosis, current injection drug use and depression. All patients were serologically negative for antibodies to human immunodeficiency virus and to hepatitis B virus surface antigen.

Patients were systematically questioned about risk factors, including past blood transfusion or surgical procedures, injection drug use, at-risk occupation, and history of hepatitis in the family. They were also asked about possible sources and transmission routes of infection as tattoos and acupuncture.

Patients enrolment and their further treatment were conducted according to the National Guidelines on treatment of CHC.

Complete blood counts, ALT, AST, bilirubin, TSH, and autoantibodies were measured before the start of therapy and during follow-up.

Serum HCV RNA levels before therapy and at week 12 and 48, and 24 weeks after treatment were analysed by a quantitative PCR assay (COBAS® AmpliPrep/COBAS® TaqMan HCV test with a lower limit of detection of 15 IU/mL, the linear range of the assay being from 43 to 69,000,000 IU/mL; Roche, Branchburg).

The HCV genotypes were determined by the hybridization technique using a VERSANT HCV genotype assay (LiPA), Bayer Health-Care LLC, Tarrytown, NY.

HCV RNA and the genotyping assays were performed in the Laboratory of HIV Diagnostics at West-Tallinn Central Hospital.

All patients underwent an ultrasound guided liver biopsy. The range of fibrosis (F) was classified according to the Metavir scoring system from F0 to F4 (cirrhosis).

All patients, depending on the genotype, were administered 48 or 24 weeks standard therapy. The Peg-IFN α-2a (Pegasys, F. Hoffmann La Roche Ltd, Basel, Switzerland) was administered at a dosage of 180 μg/week. The RBV (Copegus, F. Hoffmann La Roche Ltd, Basel, Switzerland) was given per os at a dosage of 1,200 mg/day or 1,000 mg/day depending on body weight (above or below 75 kg), for patients infected with genotype 1b; and at a dosage of 800 mg/day, regardless of the body weight, in patients infected with genotype 3a.

Written informed consent was obtained from all patients prior to the study for use of clinical data and serum samples.

**Statistical Analysis**

For statistical analysis, the χ² test, Fisher’s exact test and Student’s t-test were used.

Multivariate logistic-regression analysis was used to explore the baseline factors that could be used for prediction of SVR.

**RESULTS**

The baseline characteristics of the studied patients are shown in Table 1.

From 121 eligible patients 73 (60.3%) were males with a mean age of 38.3±11.8 years and 48 (39.7%) were females with a mean age of 42.2±11.7 years. No statistically significant difference was found between the ages of two genders (p=0.07).

In total, 76 (62.8%) of patients were infected with HCV genotype 1b and 45 (37.2%) with genotype 3a (Table 1). The mean age of patients infected with genotype 1b was significantly higher than the mean age of those infected with genotype 3a (42.7 vs. 35.1 years; p<0.01).

At baseline, the viral load of 75.2% of all patients was higher than 600,000 IU/mL, with no statistically significant difference between the genotypes (76.4% with genotype 1b vs. 73.3% with genotype 3a, p=0.894).

Of all patients who underwent a pretreatment liver biopsy, the grade of liver fibrosis was F0–1 in 91 patients (75.2%); and F2 in 16 patients (13.2%); 14 patients (11.6 %) had advanced fibrosis (F3–4) (Table 1).

Medical interventions (52.6%) followed by past IDU (13.2%) and blood donation (7.9%) were the more prevalent risk factors for patients infected with subtype 1b. For patients infected with subtype 3a the most prevalent risk factors were past IDU (40%), medical interventions (22.2%) and sexual contacts (15.6%). Other risk factors as at-risk occupation, tattoo and piercing were of less importance. For 18.2% of the patients risk factors were not identified.

According to treatment response, the patients were divided into three groups: 1) patients who achieved SVR, 2) non-responders...
(NR), i.e. patients in whom sera HCV RNA levels remained stable during treatment and 3) relapsers (RL), i.e. patients who sero-reverted to HCV RNA during follow-up. Treatment outcomes are shown in Table 2.

A total of 73 of the 121 patients (60.3%) achieved SVR after combination therapy with Peg-IFNα/RBV. The SVR rate was statistically lower for patients infected with genotype 1b compared with patients infected with genotype 3a (46.1% vs. 84.4%, p=0.00004).

Overall non-response and relapse rates were 13.2% (16/121) and 12.4% (15/121), respectively, being significantly higher for patients infected with genotype 1b compared with patients infected with genotype 3a (19.7% vs. 2.2%, p=0.01 and 17.1% vs. 4.4%, p=0.04), respectively.

Seventeen patients out of 121 (14.0%) discontinued treatment: 8 patients because of side effects and 9 patients were lost to follow-up.

The mean baseline viral load was 6.02±0.57 log IU/mL which did not differ significantly between patients with SVR (5.94±0.56 log IU/mL) and those with non-SVR (6.14±0.54 log IU/mL, p=0.058).

Out of all patients, 73.3% (22/30) with pretreatment levels of viremia below 600,000 IU/mL achieved SVR versus 57.4% (35/61) with HCV RNA levels above 600,000 IU/mL, although the difference was not significant (p=0.25). Nor was there found significant correlation of SVR with baseline levels of HCV RNA depending on the genotype (P=0.33).

Overall, SVR rate was higher for patients younger 40 years compared with older patients (76.4% vs. 47.0%, p=0.001416) regardless of the genotype.

There was found no difference between the genders in relation to SVR rate (54.8% males vs. 68.7% females; p=0.13).

The SVR rate in patients with the fibrosis score 0–1 and in patients with the fibrosis score 2–3 was 64.8% (59/91) and 66.7% (14/21), respectively, the difference being statistically insignificant (p=0.09). All 9 patients with cirrhosis (F4) failed to achieve SVR, among them 8 patients were infected with genotype 1b and one patient was infected with genotype 3a.

Multivariate logistic regression analysis showed that only two factors increased the odds of achieving SVR independently and significantly: HCV genotype 3 [odds ratio (OR), 6.359; confidence interval (CI), 2.525–16.017, p<0.0001] and patient age 40 years or less (OR 0.274; CI 0.125–0.603, p=0.0014), with no correlation with pretreatment viral load, fibrosis score or male sex.

Out of all patients, 96.7% (117/121) experienced one or more of the following side effects: fatigue − 90.1%, neutropenia − 79.3%, thrombocytopenia − 59.5%, anemia − 34.7%, depression − 24.8%, alopecia − 19.8% and myalgia − 11.5%.

Thirteen of the 76 patients (17.1%) infected with HCV genotype 1b required dose reduction of PegIFN and/or ribavirin because of adverse events. Neutropenia below 0.75 x 109/l and hemoglobin level <100 g/l were the main reasons for dose reduction of PegIFN or ribavirin. Six patients who required dose reduction achieved SVR. Three patients who required dose reduction but discontinued treatment prematurely at week 44, also achieved SVR. Three patients were recognized as non-responders, and one patient stopped treatment because of intolerance of therapy.

![Image](https://via.placeholder.com/150)

| Table 2. Responses to combination therapy with peginterferon and ribavirin of study patients |
|---------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Treatment outcomes | Genotype 1b n=76 | Genotype 3a n=45 | All patients n=121 | p-value* | | | | |
| SVR, n (%) | 35 (46.1) | 38 (84.4) | 73 (60.3) | 0.0004 | | | | |
| Non-response, n (%) | 15 (19.7) | 1 (2.2) | 16 (13.2) | 0.01 | | | | |
| Relapse, n (%) | 13 (17.1) | 2 (4.4) | 15 (12.4) | 0.04 | | | | |
| Discontinued treatment, n (%) | 13 (17.1) | 4 (9.0) | 17 (14.1) | 0.282 | | | | |

* Differences between patients infected with genotype 1b and genotype 3a

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**Table 1. Baseline characteristics of the study patients**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Genotype 1 n=76</th>
<th>Genotype 3 n=45</th>
<th>All patients n=121</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, (n, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>44 (57.9)</td>
<td>29 (64.4)</td>
<td>73 (60.3)</td>
</tr>
<tr>
<td>Female</td>
<td>32 (42.1)</td>
<td>16 (35.6)</td>
<td>48 (39.7)</td>
</tr>
<tr>
<td>Age (years), range</td>
<td>19–63</td>
<td>21–55</td>
<td>19–63</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>42.7±11.7</td>
<td>35.1±11.5</td>
<td>39.9±11.7</td>
</tr>
<tr>
<td>Viral load, (n, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤0.6 mln IU/mL</td>
<td>18 (23.6)</td>
<td>12 (26.7)</td>
<td>30 (24.8)</td>
</tr>
<tr>
<td>&gt;0.6–2.5 mln IU/mL</td>
<td>38 (50.0)</td>
<td>23 (51.1)</td>
<td>61 (50.4)</td>
</tr>
<tr>
<td>&gt;2.5–4.0 mln IU/mL</td>
<td>10 (13.2)</td>
<td>6 (13.3)</td>
<td>16 (13.2)</td>
</tr>
<tr>
<td>&gt;4.0 mln IU/mL</td>
<td>10 (13.2)</td>
<td>4 (8.9)</td>
<td>14 (11.6)</td>
</tr>
<tr>
<td>Fibrosis stage (n, %)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F0–F1</td>
<td>58 (76.3)</td>
<td>33 (73.3)</td>
<td>91 (75.2)</td>
</tr>
<tr>
<td>F2</td>
<td>7 (9.2)</td>
<td>9 (20.0)</td>
<td>16 (13.2)</td>
</tr>
<tr>
<td>F3</td>
<td>3 (4.0)</td>
<td>2 (4.5)</td>
<td>5 (4.2)</td>
</tr>
<tr>
<td>F4</td>
<td>8 (10.5)</td>
<td>1 (2.2)</td>
<td>9 (7.4)</td>
</tr>
<tr>
<td>ALT, IU/mL, range</td>
<td>16–566</td>
<td>20–505</td>
<td>16–566</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>103.7±88.2</td>
<td>143.6±109.8</td>
<td>118.4±95.5</td>
</tr>
<tr>
<td>Mode of infection (n, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical manipulationsª</td>
<td>40 (52.6)</td>
<td>10 (22.2)</td>
<td>50 (41.3)</td>
</tr>
<tr>
<td>Injection drug use</td>
<td>10 (13.2)</td>
<td>18 (40.0)</td>
<td>28 (23.1)</td>
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<tr>
<td>Sexual exposure</td>
<td>2 (2.6)</td>
<td>7 (15.6)</td>
<td>9 (7.4)</td>
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<tr>
<td>Other</td>
<td>8 (10.5)</td>
<td>4 (8.9)</td>
<td>12 (10.0)</td>
</tr>
<tr>
<td>Unknown</td>
<td>16 (21.1)</td>
<td>6 (13.3)</td>
<td>22 (18.2)</td>
</tr>
</tbody>
</table>

* Liver histology was graded according to the Metavir scoring system: F0, no fibrosis; F1, portal fibrosis without septa; F2, portal fibrosis with rare septa; F3, numerous septa without cirrhosis; and F4, cirrhosis.

ª Medical manipulations: blood transfusion and/or surgery.
DISCUSSION

Nowadays combination therapy with pegylated interferon plus ribavirin is the treatment of choice for chronic hepatitis C. Our study was designed to evaluate the efficacy of Peg-IFN α-2a and ribavirin combination therapy in Estonian treatment-naïve patients infected with HCV genotypes 1b and 3a, and to analyse the factors that might affect treatment outcome.

For assessment of treatment efficacy, we used SVR which is defined as undetectable serum HCV RNA within 24 weeks after the end of therapy.

Response to PegIFN/RBV-based antiviral therapy is influenced by different factors related to virus or host characteristics (22–24). Of the viral factors, HCV genotype has been identified as the most important baseline predictor for treatment response (25). For patients infected with genotypes 2 or 3, combination therapy is highly effective, and a 24-week course of peginterferon plus ribavirin results in SVR for 70 to 80% of patients (26–30).

For patients infected with genotype 1 and 4 and especially with subtype 1b, which is the predominant subtype in Estonia, a full 48-week course of treatment leads to SVR rate for about 50% of patients (31–34).

In our study we obtained similar data. Thus, the rate of SVR for patients infected with subtype 1b was twice as low as that for patients infected with genotype 3a (46.1% vs. 84.4%).

None-response is defined as failure to clear serum HCV RNA within 24 weeks after the start of therapy. Patients with recurrence of serum HCV RNA during the period between the end of treatment and 6 months thereafter are defined as relapsers. Relapse usually occurs in 10–15% of treated patients (35, 36). The overall rates of non-response and relapse in our study were 13.2% and 12.4%, respectively, being significantly higher for patients with HCV genotype 1b (19.7% and 17.1%, respectively).

Measurement of the viral load before and during therapy is useful in monitoring of treatment efficacy. Patients with high baseline viral loads are less likely to achieve sustained virologic response compared with those with low viral loads, regardless of the genotype (37, 38). We observed some difference in SVR rates between patients with pretreatment levels of viremia below 600,000 IU/mL and those with levels above 600,000 IU/mL (73% vs. 57%), but this difference did not reach significance.

In patients with chronic hepatitis C, advanced liver fibrosis and cirrhosis are associated with lower (up to 40%) rates of SVR to standard combined therapy (39, 40). In our study, 65% of the patients with fibrosis score 0–1 and fibrosis stages 2–3 achieved SVR, while none of the patients with compensated cirrhosis (F4) achieved it. However, the small number (9/121) of these patients did not allow to make any relevant conclusions.

In general, patient-related factors negatively influencing therapy outcome are male gender (41, 42) and older age (43). Our data demonstrated that SVR rate was higher for female than for male patients (69% vs. 55%), although the difference was not statistically significant.

The average age of patients infected with HCV is increasing, being currently 45−54 years, which is markedly different from the age 25–39 years in the past (44). In previous prospective studies on the efficacy of PegIFN and RBV combination therapy, younger age was significantly correlated with SVR and patients younger than 40–45 years showed the best response rate (21, 23, 28, 45).

In our study, half of all treated patients were older than 40 years. The overall rates of SVR were significantly higher for patients younger than 40 years compared with older patients (p<0.01).

In general, approximately 75% of treated patients experienced one or more systematic side effects, while 10–16% of patients treated with peginterferon and ribavirin had to discontinue the therapy due to adverse effects (46–49). In our study, 96.7% of patients experienced one or more side effects among which the most prevalent were fatigue, hematologic abnormalities and depression. However, adverse events were generally mild and the treatment discontinuation rate was therefore low.

Although so far several factors have been identified as predictors of treatment outcome, none of them is reliable for individualized prediction when used independently. Based on the results of our study, we made an attempt to find out which pretreatment factors might be associated with the response to combined therapy in Estonian patients infected with genotypes 1b and 3a. We demonstrated that only virus genotype (3a vs. 1b) and age younger than 40 years significantly predetermined SVR rate, while viral load and advanced liver fibrosis stage did not reach statistical significance among treatment-naïve Estonian patients with chronic hepatitis C treated with Peg-IFN α-2a plus ribavirin.

A limitation of this study might be the selection bias arising from the National Guidelines for treatment of chronic hepatitis C, which does not recommend to treat all patients older than 63 years. The mean age of patients in our study was 40, and owing to the natural course of HCV it was unlikely to expect high number of patients with F3 or F4 stages at this age. Another limitation is that the number of patients selected for the study was smaller than in most previous treatment studies in which several hundreds of patients or more were enrolled (26). However, the characteristics of patients in the present study were comparable to those reported previously and represent a true picture of CHC patients enrolled for treatment in Estonia.

Thus, the results of our single-centre study are generally consistent with the results of similar studies evaluating the efficacy of Peg IFN α-2a plus ribavirin in treatment-naïve patients with CHC. Yet there is a clear need for getting deeper insights into the host and virus nature in order to optimize the possibilities of curing chronic hepatitis C infection in Estonia.

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Conflict of interest
None declared

Sponsorship and adherence to ethical recommendations
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WHO HIGHLIGHTS IMPORTANCE OF GOOD HAND HYGIENE FOR PATIENT SAFETY

GENEVA, 4 May 2012 – On Hand Hygiene Day (5 May), more than 15 000 health-care facilities from 156 countries are participating in the World Health Organization’s (WHO) SAVE LIVES: Clean Your Hands Initiative by committing to improve patient safety by practicing better hand hygiene.

This commitment means almost 10 million health-care workers aiming to implement hand hygiene best practices, such as cleansing hands in specific moments during patient care. These steps help to combat the often hidden but persistent public health hazard of health care-associated infections.

Many of the germs causing these infections are transferred by hands when health-care providers or visitors are touching the patient while providing assistance. Using proper hand hygiene to keep hands clean is critical to reducing the risk of health care-associated infections in patients. The most common infections are urinary tract and surgical site infections, pneumonia and infections of the bloodstream.

“Health care-associated infection is a major burden around the world and threatens the safety and care for patients,” said Sir Liam Donaldson, WHO Patient Safety Envoy. “I urge the health-care community to take firm and decisive action to save lives from this preventable harm.”

Of every 100 hospitalized patients, at least 7 in developed and 10 in developing countries will acquire health care-associated infections. In intensive care units, that figure rises to around 30%, according to a recent WHO report.

A new WHO survey of more than 2000 healthcare facilities in 69 countries, found that 65% of them are at a good level of progress with regards to hand hygiene promotion, resources and activities, but at least 35% are still at an inadequate or basic level. Promising achievements in promoting hand hygiene through reminders and education of health-care workers have occurred in more than 90% of health-care facilities, but improvement is still needed in areas such as monitoring of hand hygiene practices and establishing optimal hand hygiene behaviour within a strong patient safety culture.

When working with patients, hand hygiene should be performed in specific moments either by handwashing with soap and water or by handrubbing with an alcohol-based formulation. WHO recommends alcohol-based handrub as the most effective and easiest method for hand hygiene performance during routine health-care delivery.

“But handrubs are not available or not affordable in many countries,” says Dr Benedetta Allegranzi, team lead in the WHO Patient Safety Clean Care is Safer Care program. “Improving affordability and accessibility to this simple and proven intervention will save lives, and it will require working with both public and private partners.”

To address these issues, the WHO Patient Safety Programme is launching the Private Organizations for Patient Safety (POPS), a computer-based platform for knowledge sharing to promote compliance with WHO recommendations, share information and enhance hand hygiene product availability and accessibility in all parts of the world.

For more information, please contact:
Glenn Thomas, WHO Communications Officer, e-mail: thomasg@who.int
More information on WHO’s Patient Safety programme can be found at: http://www.who.int/patientsafety/en/