USE OF CLINICAL ALGORITHMS FOR CONTINUING MEDICAL EDUCATION IN NEPAL

NSI
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INTRODUCTION

In countries with a large disparity in urban and rural development, a critical challenge exists in medical personnel retention in rural areas. Nowhere is this truer than in Nepal. In the capital Kathmandu, there are 98 physicians per 100,000 people whereas in rural areas there are only 2.5 per 100,000. Of 198 countries, only Tanzania and Malawi have lower ratios of doctors per 100,000 [1]. The resulting impact is seen in a UN Millennium Goal - Nepal has one of the highest Maternal Mortality Ratios at 830 deaths per 100,000 births [2]. Being a landlocked country with portions in the Himalayas, the remoteness of rural areas makes medical care extremely difficult.

Recruiting doctors to rural areas has been unviable. Most doctors, after training, will migrate from the rural areas to the urban areas in search of better jobs and living conditions. Doctors also will seek work in India, where work is more lucrative (Figure 1). A better alternative is to train rural persons to be mid-level healthcare workers (MLCHWs). The sponsor of the project, the Nick Simons Institute (NSI), seeks to train MLHCWs to provide medical support in rural Nepal. One problem, however, is that the MLHCWs suffer from poor clinical decision-making abilities. Lack of clinical decision-making abilities can be attributed to the emphasis on memorization rather than development of problem solving skills in the education system. To address this problem, NSI is currently developing a three-month training course for current government MLHCWs in rural Nepal that will include exercises in practical medical reasoning. This training course is an example of continuing medical education.

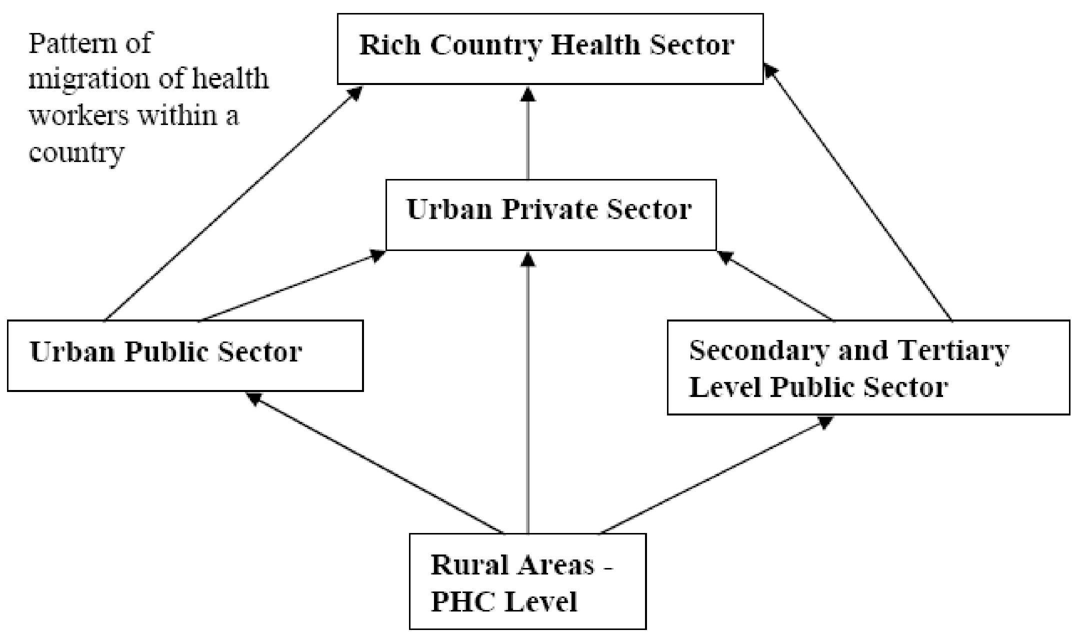

Figure 1. Migration patterns of rural healthcare workers in Nepal. Figure courtesy NSI [3].

PROJECT OBJECTIVES

Clinical skills for MLHCWs were determined by a clinical skills assessment exam sponsored by the Nepal Ministry of Health. Six categories were tested, where a perfect score was 100 percent and a passing grade was 60 percent. MLCHWs had a significant performance gap in 4 of the 6 categories, causing them to correctly diagnose disease only 21-41percent of the time (Figure 2) [4]. It was hypothesized that pediatric medicine obtained close to a passing score partially due to training using the Integrated Management of Childhood Illness (IMCI) strategy developed by the World Health Organization (WHO). IMCI is a set of syndromic guidelines and algorithms used by health-care workers to diagnose common childhood illness. Based on this assumption, NSI is exploring the use of algorithms in training current MLHCW's in clinical problem-solving skills.

The objectives of this project, then, are two-fold:

1) To establish the feasibility of training using algorithms by performing an extensive literature review on the topic;

2) To design a three-month case-based approach for training current MLCHWs, using either a technology platform or a paper platform, and test its effectiveness.

Although the main focus is on training, ultimately the training of MLHCWs is to perform point-of-care diagnostics. Hence, in the long run we expect to see MLHCWs diagnose patients at the point-of-care correctly 70 percent or better. We have designed our training with point-of-care service in mind.

Summary of Clinical Skill Scores

DOMAIN	MEAN PERCENTAGE	STANDARD	PERFORMANCE GAP
Adult Medicine	28.25 %	60 %	31.75 %
Pediatric Medicine	56.11 %	60 %	3.89 %
Maternity Medicine	34.77 %	60 %	21.23 %
Orthopedic Medicine	45.25 %	60 %	14.75 %
Procedures	58.72 %	60 %	1.28 %
Management	45.68 %	60 %	14.32 %

Figure 2. Summary of clinical skills assessment exam for current MLHCWs. A perfect score is 100 percent, and a passing score is 60 percent. Figure courtesy NSI [4].

WHAT IS AN ALGORITHM?

In the context of our project, an algorithm is a medical decision-making tool used to go from symptoms to diagnosis. This is different from most medical algorithms found in textbooks, which go from diagnosis to treatment. A sample algorithm developed for headaches by NSI is shown in the Appendix. For each of the top 20 disorders, algorithms like these have been developed by NSI-affiliated doctors. Besides using algorithms in point-of-care diagnosis, they can be supplemented with active learning methods to teach clinical problem-solving skills.

KEY STAKEHOLDER ANALYSIS

There are many stakeholders with a key role in the project. A full list can be found in the Appendix. Key stakeholders, however, are shown in Figure 3, with the size of the bubble representing individual importance. NSI, as the sponsor of the project, is an important stakeholder; a successful training program would satisfy their mission statement, as well as improve relationships with local healthcare centers, hospitals, and the Ministry of Health. However, NSI is responsible for the quality of the training, carries a financial burden, and needs to ensure that the project is sustainable. To ensure a successful training program, we will conduct a literature search for suggestions on algorithm implementation. Although NSI is in a position to fund the program, necessary donor stakeholders can be convinced by our literature search to assist in funding. Likewise, MLHCWs as the trainees can obtain higher job satisfaction and better patient-physician relationships from correctly diagnosing patients. Training, however, will take them away from their job posts and earning ability for up to four months. The idea of learning from algorithms is contrary to the usual book-learning project and may be seen as offensive. We will provide financial incentives for MLHCWs to conduct continuing medical education with NSI.

Patients have the most to gain from a better MLCHW training experience, but must be willing to accept the use of algorithms by MLHCWs in point-of-care diagnosis. We will publicize the presence of MLHCWs to convince patients to go to MLHCWs as opposed to walking to a central health center. The Ministry of Health, as the government sponsor, gains from greater health of its populace, but shares the same burdens as NSI. Cost-benefits of algorithm training must be clearly presented to the Ministry as well as to NSI. Medical educators, as the teachers of the new curriculum, need to be re-trained in new teaching methods, as well as convinced that the new active algorithm-based teaching methods are superior to old prose-based methods. Finally, if technology is implemented at the training or point-of-care level, technology providers will need to be convinced of the project feasibility through a cost-benefit analysis and proof-of-concepts of feasibility in other markets.

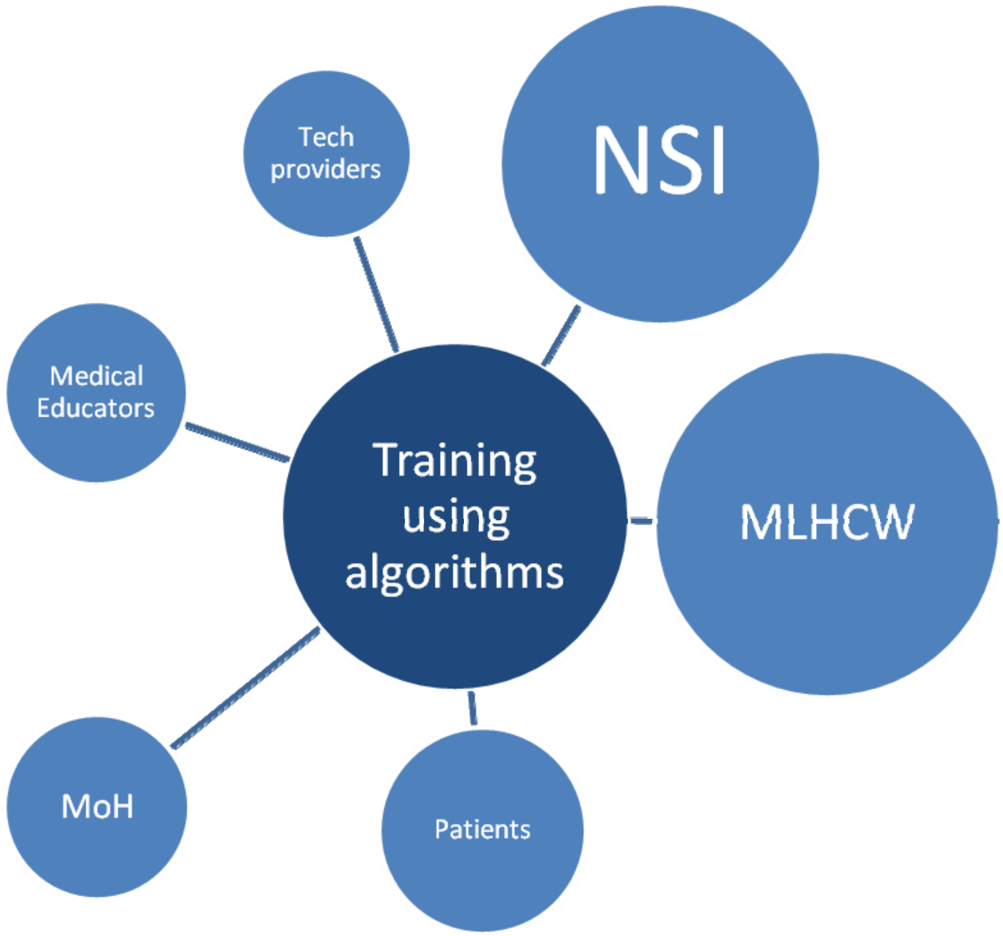

Figure 3. Key stakeholders for training using algorithms. The relative importance of the stakeholder is shown by the size of the circle.

PROPOSED SOLUTION

We propose a two part solution to training current MLHCWs in clinical problem-solving skills. The first part of this solution is to implement a three-month training program teaching the top 20 symptoms using an active format. This will include sections on principles of clinical medicine, as well as emergency aid and management of health clinics (Figure 4). The second part is choosing the platform on which to implement the algorithms - paper, PDA, or computer. Finally, we will provide all of the algorithms used in training to the MLHCWs upon completion of the course on the device used for point-of-care diagnosis as part of a kit that includes medical diagnostic equipment.

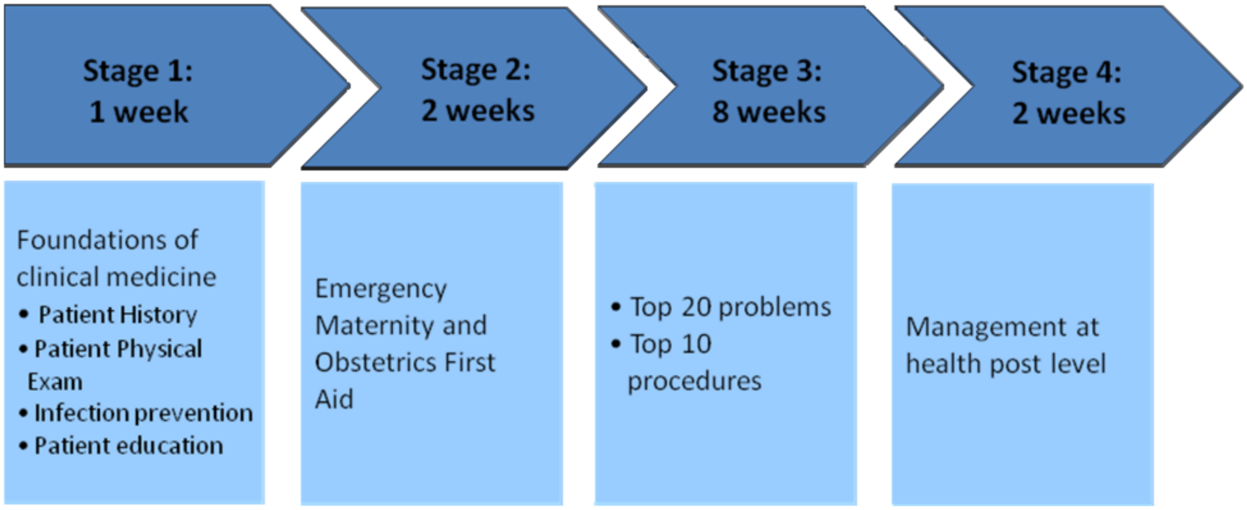

Figure 4. Proposed training plan for current MLHCWs.

PROCESS DIAGRAMS

CURRENT PROCESS

The current process diagram for training a MLHCW can be found in Figure 5. Health care workers receive an initial training of 18 months. Once they are trained, they are assigned to work in rural health clinics with no plans for further or in-service training options. NSI has found that in 21 to 41 percent of diagnoses, MLHCWs were able to diagnose their patients appropriately. The inability to diagnose a patient appropriately can be attributed to lack of necessary tools and poor diagnostic skills.

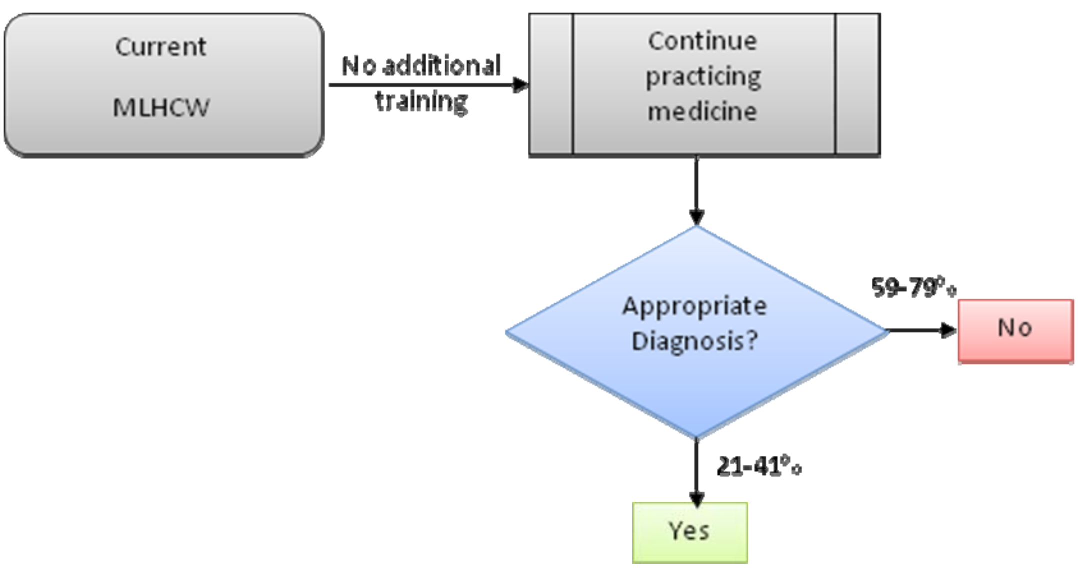

Figure 5. Current process diagram.

PROPOSED PROCESS

The proposed solution for a 3 month health care training program for MLHCWs hopes to increase the percentage of appropriate diagnoses to 70 percent (Figure 6). Current MLHCWs will be taken from their rural clinics and sent to NSI training sites. These MLHCWs will be given a clinical assessment prior to the training program. During the program, the MLHCWs will follow the program as outlined in Figure 4. After the completion of the program, the MLHCWs will once again be given a clinical assessment. The MLHCWs will then be sent back to their clinics to resume clinical care.

Because these health care workers will be away from their work site for three months, during the pilot phase of this program, NSI will send their own health care workers as replacements. MLHCWs are required to attend this program because they are government workers but they will also be offered a per diem that will more than offset living expenses while taking part in the program.

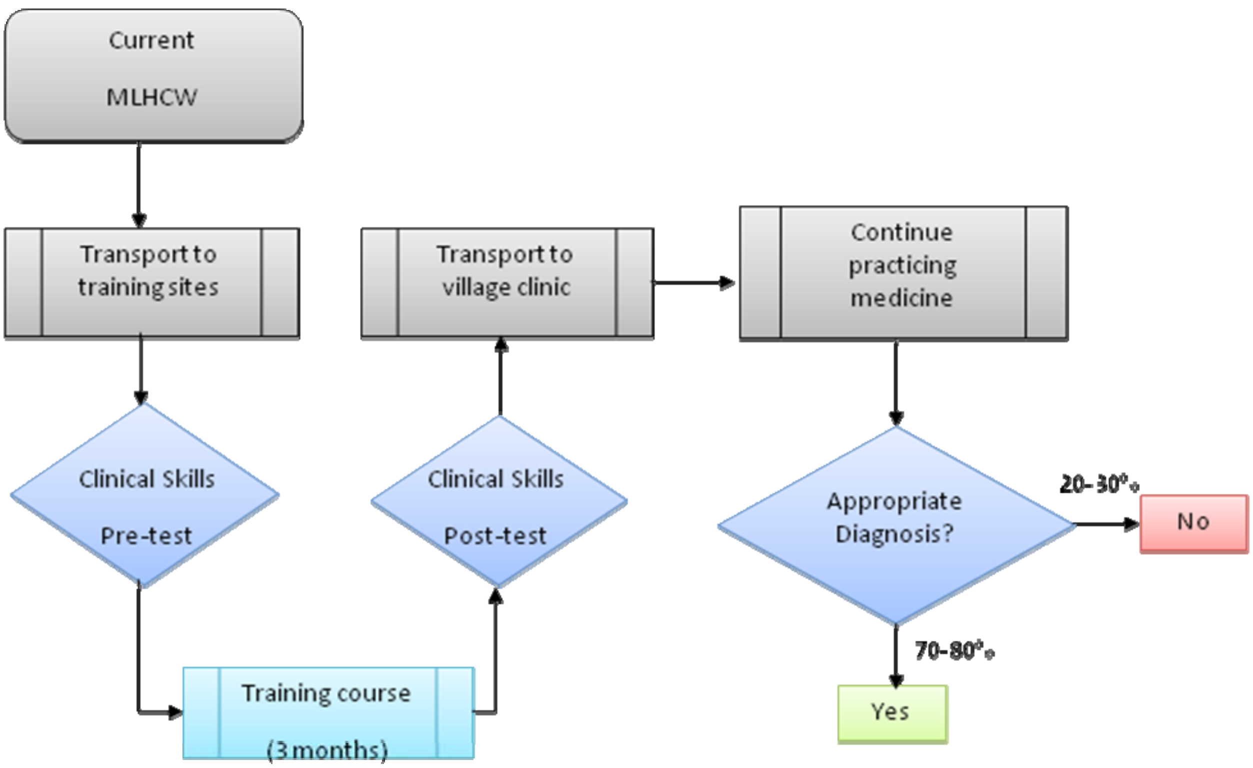

Figure 6. Proposed process diagram.

PROOF OF CONCEPT

As part of their 3 month long training program, NSI has suggested using algorithms to train the MLHCWs and also using algorithms at point-of-care after the program. To determine whether or not algorithms are an effective training and diagnostic tool, a literature search was completed.

METHOD

The specific search terms used in OVID MEDLINE are outlined in the attached form at the end of the document. Possible hits were first filtered by abstract, then by paper content. Additionally, there was a separate literature search conducted through Google Scholar as well as NIH Pubmed.

EFFECTIVENESS IN DIAGNOSIS

The use of algorithms for diagnosing patients in resource poor countries have been frequently documented in the past two decades as tools used in clinical guidelines and syndromic management. The WHO strongly promoted the use of syndromic management guidelines for sexually transmitted infections (STIs) especially for resource poor countries in 1990s. Syndromic management is a diagnosis and treatment process relying on observed symptoms rather than on laboratory test results. For resource poor countries who often cannot afford diagnostic tests, syndromic management is the best viable option. The WHO's support for syndromic management policy increased after the effectiveness of syndromic management intervention was found to decrease transmission of HIV through management of STIs by 38 percent [5].

The WHO was also involved in implementing the Integrated Management of Childhood Illness (IMCI) strategy worldwide. The IMCI is a set of comprehensive strategies which have been employed effectively in Brazil, Peru, Uganda, Tanzania, and Bangladesh to tackle childhood illness. The IMCI guidelines have included the effective use of algorithms to diagnose childhood illness. Such implementation has, in sample cases, reduced childhood mortality by 13 percent over two years in Tanzania while maintaining lower cost than without IMCI intervention [6]. IMCI training also increases sick patient visits to first level hospitals (more than two-fold in a study in Bangladesh), indicating higher patient confidence in the health system [7].

Using symptoms to diagnose and treat has also been found to be effective in Nepal [8]. A study examined the feasibility of exclusively relying on indigenous community health workers with limited training to diagnosis and treat children with pneumonia using specific, observable clinical signs. By the end of the three year trial, on average, 80 percent of pneumonia cases were diagnosed correctly and treated. A statistically significant decrease in child mortality was also observed. However, researchers suggested that the program's success was in part due to the training program and management efforts. Training the health workers for no less than nine days was required to ensure that the quality of the intervention services was sufficient. Close attention by management was also required through supervisory visits every two weeks.

Otherwise, there are many examples of symptomatic-diagnosis algorithms which are more effective than random diagnosis or diagnosis through personal judgment. When using the ROAD algorithm to determine adult death in emergency response, errorless diagnoses were made 93 percent of the time as compared to 40 percent when using personal judgment [9]. Among dietitians with on average a B.S. training, nutrition status algorithms were 25 percent more effective in determining status than personal judgment [10]. Algorithms implementing IMCI in Vietnam for referral to the hospital by nurses after identification of severe disease were shown to be >60 percent sensitive and >85 percent specific as compared to a pediatrician diagnosis [11]. Studies indicate that algorithms for end-user diagnoses, especially for those without extensive medical training, can be highly effective.

EFFECTIVENESS IN TRAINING

Although algorithms for diagnosis are used extensively in the developing world, there is less data on the use of algorithms for training clinicians in clinical skills. The need for such training is evident based on research conducted by the NSI – in a survey of 163 Nepali MLHCWs, a significance performance gap was found between clinical skills in adult, maternity, and orthopedic medicine (28.25 to 45.25percent) versus a standard (60 percent) proposed by the Council for Technical Education and Vocational Training. This gap exists despite adequate theory training (judged by testing). Interestingly, there is almost no gap between clinical skills in pediatrics (56.11percent) versus the standard (60 percent) – the authors contribute this to interactive IMCI training, in which 73 percent of MLHCWs have participated [4]. Similar data has been found in Ghana – in a study testing over and under-dosage of malaria treatments among medical assistants, it was found that within year knowledge gained from lectures and case study presentations "deteriorated" and over-prescription continued. The study concluded that there was a significant knowledge / practice gap which needed to be remedied through alternative training methods [12].

There is a general consensus that active training methods are more effective than passive training methods. Most notable is a review of 41 methods of training physicians and their associated effects and found that passive approaches through lectures were generally ineffective as compared to active approaches, and that multi-faceted training methods are better than single methods [13]. This finding has been repeated in controlled experiments comparing doctors' practicing ACLS (advanced cardiac life support) procedures vs. pure cognitive learning [14]. Teaching of critical thinking methods to nurses through the use of "thinking maps" encouraging drawing inferences and thinking aloud has also been demonstrated [15]. Finally, guidelines given to general practitioners (non-experts) have been shown to invoke thought processes similar to that of specialized medical practitioners during diagnosis of complex diseases. However, the authors also stressed limitations of algorithms. Because of the simplified nature, algorithms alone often are unable to provide the detailed background information or explain the counter intuitive advice to students [11].

There are fewer studies, however, on the effectiveness of teaching algorithms. In one study, prose was compared to clinical algorithms for teaching medical students decision making in diagnosing child meningitis and fever; these medical students were then tested with hypothetical cases. The clinical algorithm-trained group had better test results and learned the skills faster than the prose-trained group. The algorithms used can be found in the reference [16]. The same effect was also seen by comparing learning efficiency (test score gain vs. study time) of PHP's being trained in rheumatology through algorithms, textbook learning, or no training [17]. Modifiable algorithms for teaching nurses and patients common AIDS symptoms were also developed and implemented successfully [18].

However, algorithms have not been universally shown to be the best teaching tool for diagnosis and problem solving. One paper cited a lack of major evidence for or against "problem-based learning," but has developed guidelines for teaching algorithms [19]. Among dermatology residents trained to diagnose melanocytic lesions, "pattern analysis" yielded better diagnostic performance than simplified algorithms composed of a 7-point checklist or a "ABCD"-rule-based guideline approach [20]. There is also a warning against stringent clinical guidelines provided by experts; overemphasis can cause students to "force" individuals who do not easily fit into an algorithm-defined category into one, thereby decreasing individualized care [21].

Likewise, there is little information available about implementing educational algorithms in a Nepali context. The only notable case involves the implementation of the WHO Practical Approach to Lung Health (PAL) in Nepal, where MLHCWs were trained using the same algorithms as they would be using in diagnosing respiratory illness in an active manner (e.g., patient demonstrations and clinical exercises) [22]. Although training algorithms have been limited in the scope in their target treatments (a single diagnosis), the success of programs when targeted towards those with less medical education and the global success of IMEI training indicate that diagnostic algorithms can be used as a learning tool for a more generalized set of maladies.

ALGORITHMS DESIGN

Algorithms for training in "clinical-problem solving" and for diagnosis have general guidelines for successful implementation. A general review of important diagnostic and therapeutic concepts to teach in clinical problem solving, along with references to papers dealing with such, can be found in Table 1 of a New England Journal of Medicine editorial [19]. The general components of a clinical algorithm is outlined in another review, which warns that algorithms are most effective when targeted towards postgraduate education as opposed to undergraduate or professional [23]. Specifically, there is an extensive discussion available regarding the successful design of AIDS syndrome algorithms; of 6 algorithms developed, it was found that visual algorithms are better than textual ones, that testing for the simplicity of terminology by a SMOG readability formula is essential, and that patient feedback is important to modify algorithm appearance [18]. The importance of modifiable algorithms has been reaffirmed in a study developing protocols to treat acute respiratory distress syndrome, which saw algorithm usage increase from 41 to 90 percent as revisions were made and patient survival rate increase from 9.5 to 44 percent [24].

RECOMMENDATIONS

Based on the preliminary literature search, we believe that there is ample evidence of the use of algorithms for end-user diagnosis and fair evidence for the use of algorithms in teaching clinical problem solving. However, we found few discussions on implementing algorithms for a wide range of disease states as opposed to a handful of disease states. In designing algorithms, we recommend the following in order to overcome some limitations identified through our research, such as oversimplification, misdiagnosis through rigid algorithms, and poor accessibility:

- Using visual formats and ensuring readability, as well as incorporating end-user (MLHCW) feedback;
- Providing exit paths out of designed algorithms to accommodate case variation or complex scenarios;
- Supplementing algorithms with active training methods to clarify diagnoses; and,
- Considering the use of technology such as inexpensive PDA's to display algorithms as opposed to paper, especially if algorithms targeting the top-20 disorders are to be created.

With regards to the final recommendation, there have been studies done migrating algorithms to a digital format which have been more effective than paper formats. Specifically, IMCI algorithms were ported to PDA's for use in Tanzania, and have resulted in improved care through avoidance of unintentional deviations by healthcare practitioners [25]. The e-IMCI protocols on the PDAs were demonstrated to "reduce skipped steps, branching-logic errors, miscalculations, and a reduction in training time." Also, the authors argued that updating and redistributing electronic protocols are easier than those on paper. Platforms, such as ComCare developed at University of Washington, a Windows Mobile application developed by Dimagi, and JavaRosa developed by DTree and CellLife, can be modified to implement new algorithms for use in diagnosis [26]. We hypothesize that extensive algorithms will require a digital platform to ensure usability, and are currently investigating usage of such methods.

PLATFORM COMPARISONS

After the effectiveness of algorithms had been proven in training health care workers and also in diagnosing patients, we addressed the question of how to display the algorithms for classroom and point of care use.

METHOD

Three types of platforms are considered: paper, PDA, and computers. A separate analysis was conducted for classroom and point of care because the platform requirements vary between these two settings. A list of desirable platform characteristics was created under the categories of Functionality, Cost, and Requirements.

Because some characteristics may be more important than other, each characteristic was given a weight from zero to one. The weights sum to one to allow the weights to be comparable to each other. For example, a weight of 0.20 signifies a characteristic that is twice as important to the sponsor as one with a weight of 0.10. Characteristics that are not applicable or not even considered are not given a weight. Because the importance may change in different environments, the weights will change for the classroom and the point of care analysis. In the following analyses, we approximated the weights for each characteristic. These are subjective values and can be adjusted.

For each characteristic listed, each platform is assigned a value of 1 (Yes), 2 (Maybe), or 3 (No). If the characteristic accurately describes the platform, a value of '1' is assigned. If the characteristic describes the platform with some degree of accuracy, a value of '2' is assigned. If the characteristic does not accurately describe the platform, a value of '3' is assigned.

To compute an overall score, each value assigned to the platform is multiplied by the assigned weight for the respective characteristic. The weighted sum is the sum of the weighted scores across all characteristics. The best platform would have the lowest weight total scores.

RESULTS

CLASSROOM

In the classroom, algorithms will be used to train MLHCWs the thought processes behind diagnosing patients and also act as a diagnosing tool (

Table **1**). "Mobile" and "Improves adherence" were removed from the analysis because these are not relevant characteristics when considering a platform for classroom use. Because students will not be traveling with their algorithms, whether or not the platform is mobile is not relevant. Adherence to protocols has been shown to be an issue in the field where health care workers begin memorizing algorithms which leads to potential errors in diagnosing a patient. Because the MLHCWs are in a learning environment where adherence is not a potential problem, the ability of the platform to improve adherence is not considered.

The highest weight of 0.30 is placed on "No additional training" because in an educational program, using a platform that did not require a substantial amount of time to learn how to use the technology would be beneficial in order to focus on learning the course content.

Table 1. Classroom platform comparisons.

	Weight	Paper	PDA	Computer
Functionality				
Mobile	--	--	--	--
Varied Capabilities	0.10	3	2	1
Access to Network	0.05	3	1	1
Easy to update	0.05	2	1	1
Improves adherence	--	--	--	--
Cost				
Low Hardware & software	0.20	1	2	3
Minimal Maintenance & Support	0.15	1	2	3
Requirements				
Does not need power source	0.05	1	3	3
No Additional Training	0.30	1	2	3
Limited safeguards against theft	0.10	1	1	3
	Weighted Total:	**1.35**	**1.85**	**2.40**

Key:

1 - Yes

2 - Maybe

3 - No

At the point of care, the MLHCWs will be using the algorithms as a tool to assist them in diagnosing patients they encounter at the rural clinics (

Table **2**). “No additional training” was removed from this analysis because MLHCWs using the diagnostic algorithms will already have been trained in platform use. The greatest weight was assigned to mobility and ability to improve adherence. Because MLHCWs are working in mountainous rural areas, having these diagnostic algorithms in a mobile format would allow greater flexibility in reaching patients that may not be able to travel to the clinics. Also, improving adherence to the algorithms decreases the opportunities for skipping steps that could lead to misdiagnosis.

Table 2. Point of care platform comparisons.

	Weight	Paper	PDA	Computer
Functionality				
Mobile	0.35	1	1	3
Varied Capabilities	0.05	3	2	1
Access to Network	0.05	3	1	1
Easy to update	0.05	3	1	1
Improves adherence	0.15	3	1	1
Cost				
Low Hardware & software	0.10	1	2	3
Minimal Maintenance & Support	0.05	1	2	3
Requirements				
Does not need power source	0.15	1	3	3
No Additional Training	--	--	--	--
Limited safeguards against theft	0.05	1	1	3
	Weighted Total:	**1.60**	**1.50**	**2.40**

Key:

1 - Yes

2 - Maybe

3 - No

CONCLUSIONS

In the classroom, paper had the lowest score of 1.35. Based on our initial analysis, we conclude that paper may be the best option on which to train MLHCWs with algorithms (

Table **3**). Paper has low cost, mobile, and limited requirements although it does not provide the wide range of capabilities that PDAs or computers offer. Each platform has benefits and limitation but paper is the best overall option as a platform for training algorithms.

At point of care in the rural clinic, PDA had the lowest score of 1.50 – slightly lower than paper by 0.10 points. This result suggests that PDA is the best option for using algorithms in the field although only slightly better than paper. The proven ability of PDAs to improve adherence to medical algorithms and its mobility are key reasons to prefer PDA over both paper and computers.

Table 3. Summarized Results of Platform Comparisons.

	Paper	**PDA**	**Computer**
Classroom	1.35	1.85	2.40
Point of Care	1.60	1.50	2.40

SWOT ANALYSIS

Our SWOT (Strengths Weaknesses Opportunities Threats) analysis categorically inspects the different factors of the economic, political, social, and cultural environment surrounding the implementation of our proposed training program (Figure 7). These factors can either be helpful or harmful to the program and internal or external to the providers of the program. The Strengths category describes factors internal to the organization that are helpful to the implementation of the program. The Weaknesses category describes factors internal to the organization that are harmful to the implementation of the program. The Opportunities category describes factors external to the organization that are helpful to the program. Finally, the Threats category describes factors external to the organization that are harmful to the implementation of the program.

STRENGTHS

One of the strengths for our proposed training program is that NSI has committed to a structured 3-month training course for the MLHCW's (Figure 4). NSI already has financial resources available for and earmarked towards the training program so that the program does not need to be concerned about finding immediate funding or generally a training course syllabus de novo.

Another strength of our algorithm-based training program is that it has been proven within Nepal to be a more effective training process than the current text-based training program. In addition, use of algorithms has been shown to improve clinical diagnostic skills at the point-of-care. Finally, NSI has the necessary technological infrastructure required to support the different potential platforms on which algorithms could be displayed. The NSI headquarters in Kathmandu, where MLHCWs will travel for their training, has access to electricity needed for recharging PDA's and powering computers.

WEAKNESSES

One weakness of our program is that NSI is focused on quality and efficiency of the training of MLHCWs, as stated on their website, but not necessarily on quality and efficiency of service at the point-of-care. While improvements in training can be assumed a priori to lead to improved diagnostic skills, when considering the appropriate platform for algorithms, requirements for both training and point-of-care must be taken into consideration.

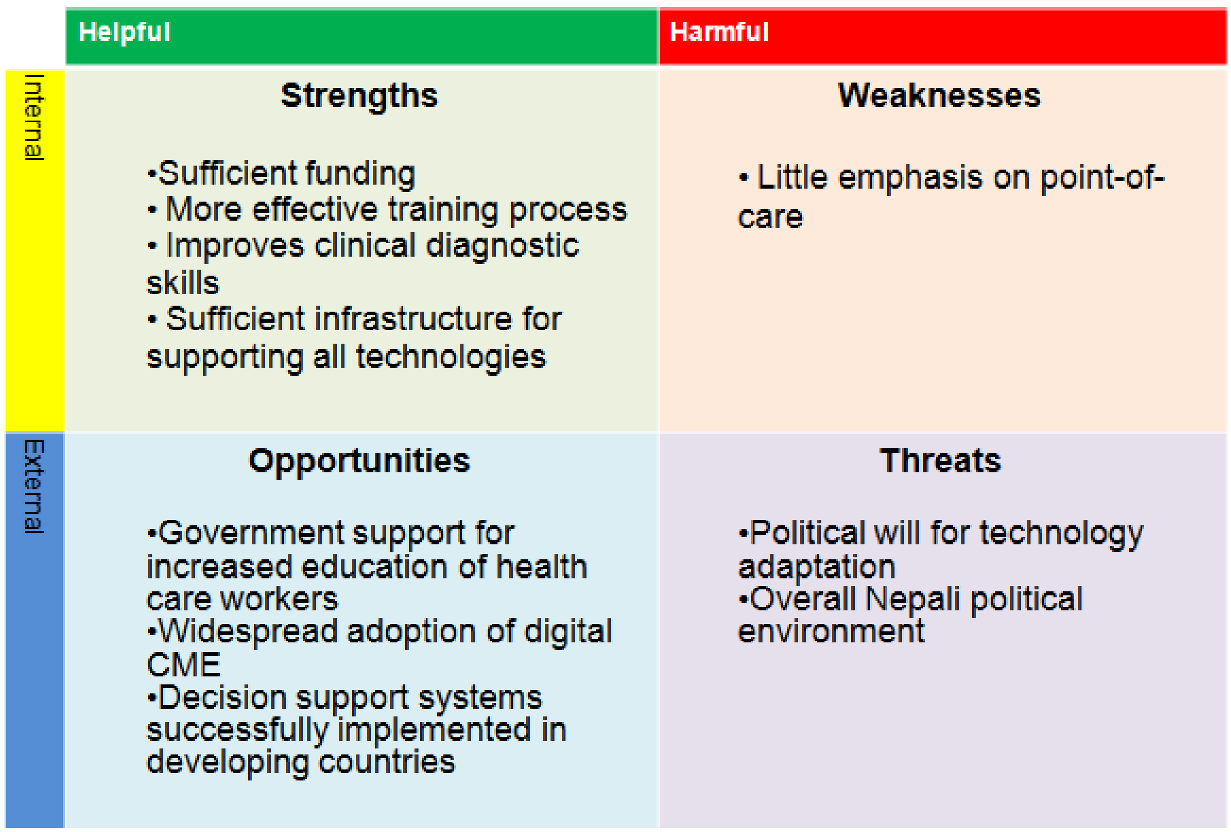

Figure 7. SWOT analysis essentials.

OPPORTUNITIES

One of the factors external to NSI that is helpful to our proposed training program is government support for increased education of health care workers. Working in line with the Ministry of Health's goals is important as the majority of Nepal's hospitals are publicly owned. In addition, government support and collaboration are important for the sustainability and possible expansion of program. Evidence that decision support systems have been successfully implemented in other developing countries also supports our project.

Also, another external factor beneficial to our project is the widespread adoption of digital CME as a platform in other countries. Digital CME has been proven to be beneficial to elevating the quality of the health care system in other countries. The international background provides adequate proof of concept for algorithm training use in health care which allows us to focus on implementation and adaptation to the Nepali health care system.

THREATS

Threats to the adoption of our proposed training course include the political will for technology adaptation and the current overall Nepali political environment. We have assessed the difficulties associated with a switch from text-based learning to algorithm learning. These include costs of implementing a new program, resistance from the medical community to changing the way people learn and the uncertainty of the success of the program. Our literature review has adequately addressed these issues by proving the superior learning efficiency ratio of algorithm learning to text-based learning in other settings. Our literature review also addresses the mental paradigm shift associated with switching from text-based to algorithmic learning processes. Our research shows that health care workers readily adapt to algorithmic learning.

In addition the instability of the current political situation in Nepal poses a threat to our program implementation as well. We are confident that our proposed training program has shown advantages over the current training process and would benefit the Nepal health care system regardless of political leadership. However, straining of resources during this politically unstable period and safety act as factors for postponing the introduction of the program.

PROGRAM EVALUATION

Our platform comparisons show that paper is the platform that would most meet NSI's requirements for a training platform. For our third and final track, we will quantitatively monitor and evaluate the ability of the program to meet the needs of our stakeholders.

Our first task will be to determine the effectiveness of paper as a CME platform for algorithm usage. We will give the clinical skills Assessment exam to the 45 MLHCW students being trained before and after their training with algorithms on paper platforms. As described before, the clinical skills exam is adapted from of a Ministry of Health instrument that measures the ability of MLHCW's to diagnose.

The efficiency of the training will be analyzed using several outcome measurements based off of the students' scores. First the absolute score on each of the sections of the clinical skills exam will be compared before and after the training program to determine the improvement in clinical skills based solely from the training program. Then the learning efficiency ratio will be calculated as the change in clinical skills assessment test score over the amount of time the students spend learning the algorithms.

We aim to measure the absolute score increase and learning efficiency ratio for every successive class participating in the program to continuously monitor the efficiency of the program. We will also ask for qualitative input from the students in the form of focus groups to gage and maintain the appropriateness and relevance of the material so that the training most accurately reflects the needs and addresses the concerns of the MLHCWs.

CONCLUSIONS

The main goals of our major stakeholders is to more effectively train Nepali MLHCWs in order to improve their diagnostic skills and ultimately, the quality of health care in rural Nepal. The literature on educational training methods has demonstrated that algorithms are more effective than prose or text-based learning in medical training. In addition, based on our platform comparison analysis, paper algorithms meet more requirements if the focus is on education while algorithms on a PDA platform are the best option for point-of-care diagnosis. Based on these findings, we recommend teaching analytical skills using algorithms in the classroom and spending some time training on PDAs in preparation for point of care.

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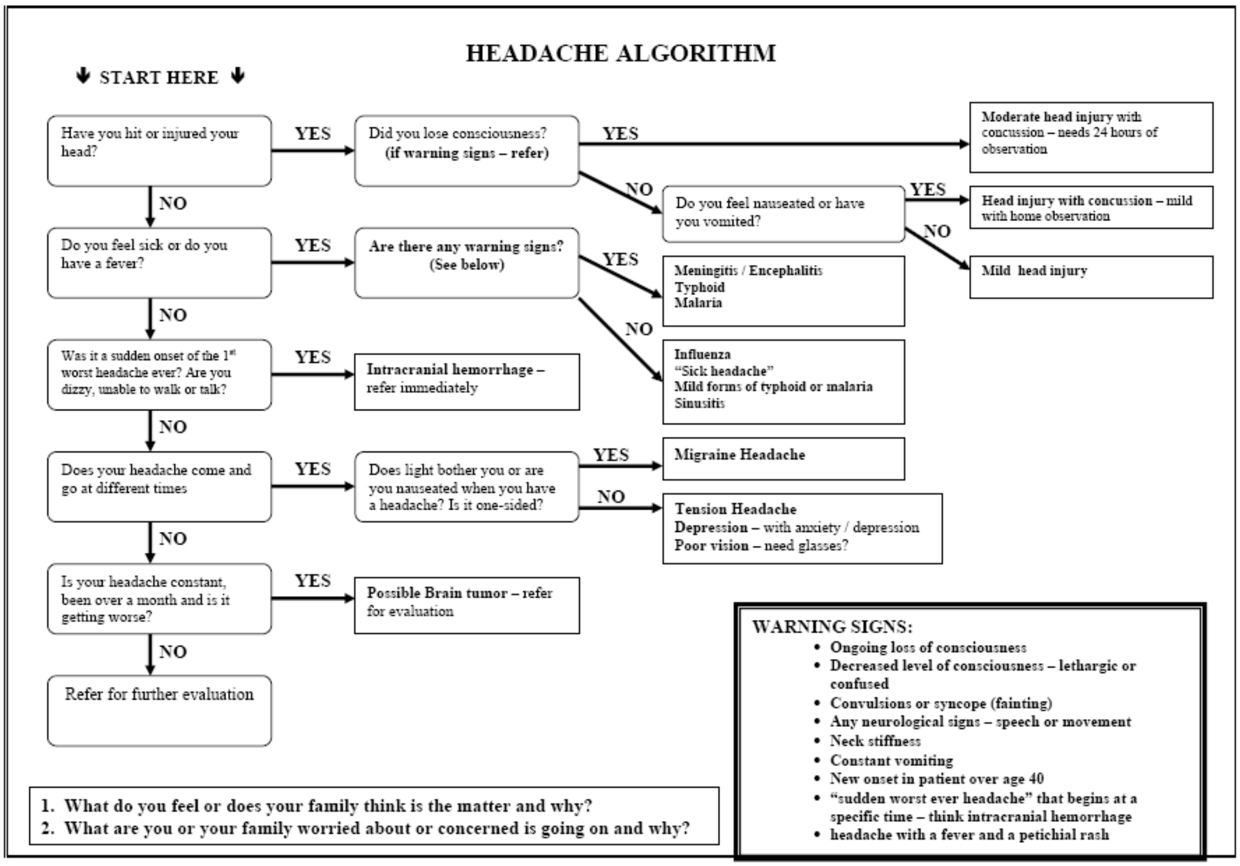
APPENDIX

SAMPLE HEADACHE ALGORITHM



Stakeholder	Importance to Me	Positives	Negatives	Importance to Stakeholder	Strategy
Patient	High	• Improved quality of care and health • Greater access to CHW	• Still must walk to local CHC if HCW not visiting village	High	Mobile CHWs visit villages on prescheduled dates Public health programs targeting rural populations
Mid-level health workers	High	• More accurate diagnosis leading to patient trust • Learning new skill sets • Increased interaction with patients by traveling to villages • Increased job satisfaction	• Guaranteeing security of new hardware • Training and learning curve • Troubleshooting technology failures • Increased work load • May find learning from algorithms offensive	High	Quality control regulation of new hardware Evidence-based efficient training algorithms Ease of use of new technology Ease of use of new technology manuals Build health system capacity to accommodate increased work load (more medical schools, more training

					hospitals) Incentives for continuing education
Ministry of Health	Medium	• Increased population quality of health • Meeting international health standards	• Budgeting for changes to health care delivery in rural areas • Risk of failure • Project sustainability • Financial burden	High	Cost-benefit analyses to support policy decisions Focus groups for health policy decisions composed of all major stakeholders Increased communication and coordination with international health community, NGO's, private sector Detailed analysis and projection of project costs
NSI	High	• Improve partnerships with local healthcare centers, hospitals, and MoH	• Responsible for training • Financial burden • Risk of failure • Project sustainability	High	Convince NSI of need to incorporate technology with algorithms Consult education experts for

					optimally efficient training program Convince donor stakeholders of the importance of funding training program using solid evidence-base
Domestic NGO's	Medium	• Health improvements also help their mission statement	• Overlap of responsibility/roles	Medium	Consult with other NGO's; ensure no overlap, or work off overlap
Global NGO's	Medium	• Will have a risk-free trial of seeing if algorithms for teaching/diagnosis work	• Application Nepali-oriented	Low	If other NGO's doing similar stuff, consult for advice
Tertiary hospitals	Low			Medium	
Doctors	Medium	• If public work doctors, reduces workload • Overall goal of improved patient health	• May view as taking work away if private practice doctors • May find learning from algorithms offensive	High	Consult Nepali doctors for opinion; encourage for support (govt. goes to them for advice)
Health Centers	High	• Increased patient flow • Improved relationship with villages • Better equipped health centers	• Guaranteeing security of new hardware	High	Must demonstrate how training CHW and adopted proposed changes will increase patient flow and

					revenue
Technology Providers	High	• Sales of software/hardware • Product testing • New market entry • New partnership with NSI and Nepal government	• Risk of unknown market • Difficulties in providing technology support	High	Demonstrate application feasibility in other markets / pilots Conduct cost/benefit analysis
Medical Educators	Medium	• New skill set	• Learning curve • Responsible for teaching new technology and new method of learning	Medium	Provide educators incentive to relearn medical teaching methods
Employers of patients	Low	• Improved work productivity of employees from improved health	• Employee must take time away from work to visit CHC	Medium	
Academic Institutions	Medium			Medium	
Traditional Healers	Medium		• Takes away business	High	Train traditional healers to complement the health system

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Current Search History

Ovid MEDLINE(R) 1950 to Present with Daily Update

#	Searches	Results
1	algorithm$1.sh,ti.	84998
2	limit 1 to english language	79876
3	limit 2 to yr="1986 - 2008"	79335
4	teach$3.ti.	33407
5	Education, Medical/	37817
6	4 or 5	66884
7	3 and 6	75
8	from 7 keep 1-75	75
9	Clinical Competence/	40404
10	3 and 9	152
11	Teaching/ or Inservice Training/	45742
12	3 and 11	110
13	10 or 12	248
14	13 not 8	220
15	from 14 keep 1-220	220
16	Decision Making/	45221
17	3 and 16	411
18	17 not (7 or 14)	388
19	Education, Nursing, Associate/ or Education, Medical, Undergraduate/ or Education/ or Education, Professional/ or Education, Nursing/ or Education, Medical, Graduate/ or Education, Medical, Continuing/ or Education, Nonprofessional/	82674
20	3 and 19	103
21	20 not (7 or 4 or 18)	88
22	from 18 keep 1-388	388
23	*"Patient Education as Topic"/	22343
24	3 and 23	55
25	24 not (7 or 14 or 18 or 21)	45
26	from 7 keep 3, 9-10, 18, 34, 38, 40...	19
27	from 26 keep 1-19	19
28	from 14 keep 21, 26, 28, 42, 54, 68...	26
29	from 14 keep 218, 220	2
30	from 18 keep 2, 61, 65, 153, 165, 175...	13
31	from 21 keep 43, 56, 58, 82, 88	5