



Implementation of a Diagnostic Ultrasound Program in Rural Nepal

Summary of the Program

Diagnostic imaging is largely unavailable to rural, impoverished communities throughout the world. In the area where Nyaya Health works in the district of Achham in western Nepal, there is no ultrasound capacity for a region of over one million people. To meet the diagnostic needs of patients in Achham, Nyaya Health has started an ultrasound program using a GE LogicBook E machine provided by International Aid. This program was initiated on August 14, 2008. This report describes the first month of the program, in which 60 patients received a diagnostic ultrasound.

About Nyaya Health

Nyaya Health is a 501(c)(3) non-profit organization working with communities in Nepal and with the Nepali Ministry of Health to develop healthcare services in the poor, western regions of the country. The district of Achham is a rural agricultural area with some of Asia's highest poverty, infant mortality, maternal mortality, and HIV incidence rates. Our mission in Achham is two-fold: to establish essential public health services in one of the world's most underdeveloped areas, and to develop a model program that establishes how to scale-up and manage comprehensive healthcare services in remote, resource-deprived areas.

Relevant statistics of the district

- Number of citizens: 250,000
- Number of doctors (excluding Nyaya Health): 1 (located 5 hours from the clinic)
- Number of ultrasound machines: 0 (none in an area covering over 1 million people)
- 99.5% of babies are delivered outside a health center
- 1 in 125 deliveries result in death of the mother
- 60% of children are chronically malnourished
- Average person makes \$150 a year
- Over 50% of the men migrate to India in search of work
- Over 7% of the men returning from Mumbai are HIV-positive
- Nearest functioning airport and hospital: 10 hours by bus, costs 1 month's average income

Present Activities

The heart of Nyaya Health activities in Achham is a four-bed, five-room clinic focusing on primary care, maternal and child health, HIV, and tuberculosis. Our clinic is run by an all-Nepali staff consisting of a physician, community healthcare workers, midwives, lab technicians, and project managers. We are expanding a network of community health workers who provide essential outreach and triage services to our geographically dispersed population. These services have been developed in collaboration with the government of Nepal; our ultimate goal is full integration of our services with the developing public-sector health program. Over the next year, we are constructing a community telemedicine center, applying information and communication technologies in

innovative ways to improve the effectiveness and equity of our health services. We are also renovating, restocking and staffing a hospital that was abandoned 25 years ago to expand our medical, obstetric, and surgical capacity. Our long-term vision is to work with local communities as part of a global healthcare movement that: (1) facilitates resource distribution to resource-denied areas; (2) fosters grassroots collective action; (3) involves the central government in pro-poor health infrastructure; and (4) achieves transparency and collaboration in global health delivery.

Program Overview

Machine Specifications

The machine is a Logiq E portable ultrasound with the following probes:

4C-RS 2.0-5.5 MHz Wideband Convex Probe - Abdomen, OB Gyn

E8C-RS 4.0-10.0 MHz Wideband Microconvex Endocavity Probe - OB Gyn, Urology, Endocavity

3S-RS 1.5-4.0 MHz Wideband Phase Probe - Cardiac, ABD, OB Gyn

12L-RS 5.0-13.0 MHz Wideband Linear Probe - Vascular, Sm. Parts, Musculoskeletal, Nerves, Pediatrics

During clinic hours, the machine is to be placed in its bay in the delivery suite. Off hours, the machine must be locked in the storage area. Following each use, sanitation fluid is to be applied to each probe used. At the end of each day, the midwife-in-charge is to wipe the probes and machine down with sanitation solution.

Appropriate Use

Only those uses that are pre-approved by the Nyaya Health board of directors, in consultation with the Yale Section of Emergency Medicine, may be utilized at the medical clinic. Dr. Christopher Moore oversees the program from the Yale side. Beyond these pre-approved uses, there are NO appropriate applications. Use of the machine by staff outside of these preapproved uses may be grounds for disciplinary action. These appropriate uses are limited to those described in the ultrasound form. The following are the presently approved uses:

- Obstetric: evaluation of viable IUP, fetal products gestational age, fetal lie, placental location
- Vascular: intravenous line placement
- Renal: evaluation for hydronephrosis
- Abdominal: evaluation for free fluid
- Pulmonary: evaluation for pneumothorax or effusion
- Cardiac: evaluation of myocardial dysfunction or pericardial effusion
- Skin/soft tissue: evaluation of abscess

All patients must be properly informed of the risks and benefits of ultrasound. All patients must be cleaned off thoroughly from the gel.

Protocol for Ultrasound Research and Review

- every patient must have a completed and accurate form filled out
- ultrasound log is transcribed to database at end of each week
- database is forwarded to EM group over secure FTP each month
- ultrasound images and clips forwarded to EM group over secure FTP each month
- Yale EM group provides feedback about ultrasound use

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Summary of Program to date

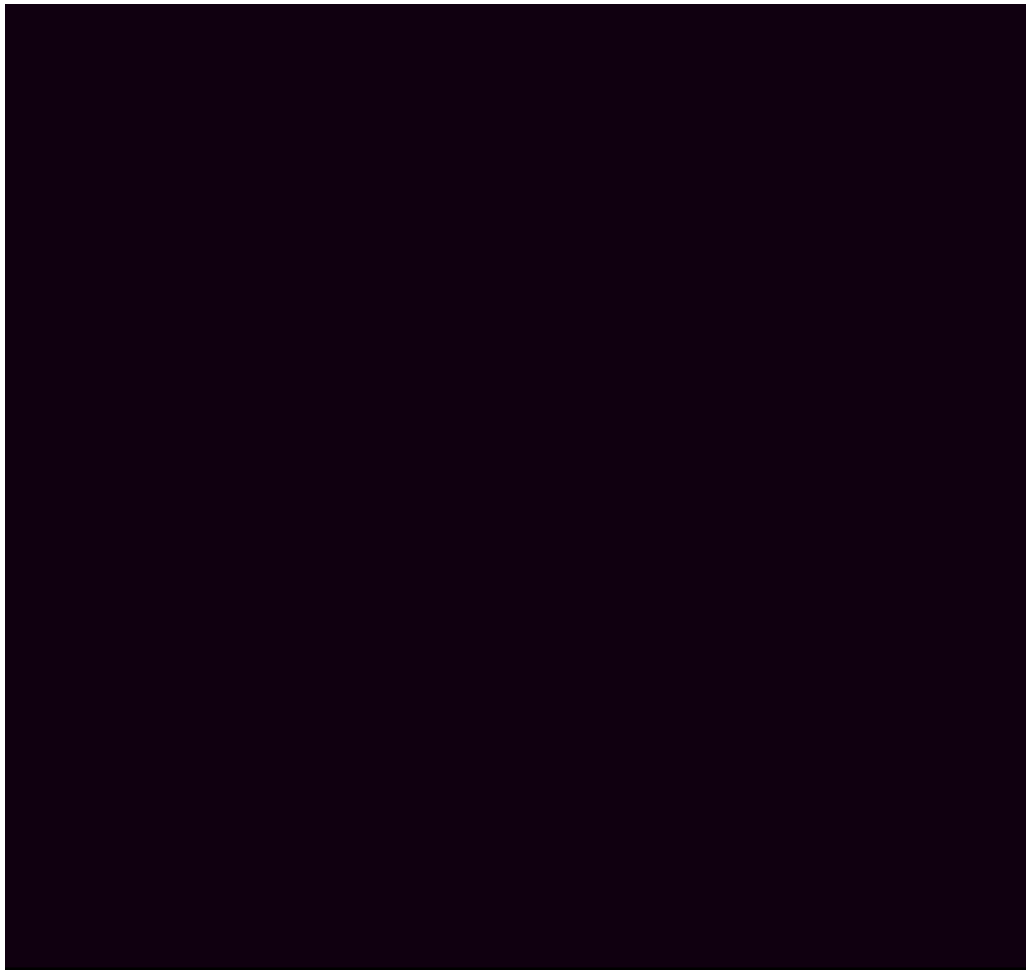
We have used ultrasound to evaluate 25 obstetric patients and 35 non-obstetric patients during the first month of operation. With minimal prior training, our Nepali physician has quickly become proficient in the use of basic, essential diagnostic ultrasound for obstetric, abdominal, and soft tissue applications. The below cases and photos provide a snapshot of some of the kinds of problems addressed in the first month of ultrasound; the following tables provides an overview of all the patients seen.

Case Report #1: Placenta Previa

A 25 year old, gravida 3 para 2 presented to the clinic for routine antenatal care and second trimester ultrasound. The ultrasound revealed a normal fetal heart rate and excellent fetal activity. The placenta was seen in posterior position, with a small portion overlying the internal os. The patient is given routine antenatal care and instructed to return to clinic in two months to reassess placental position.

Case Report #2: Neck Abscess

A 50 year old woman presented to the clinic with large neck abscess overlying neck vessels. It was unclear how deep the abscess was, and what its relation to carotid and jugular veins was. Ultrasound revealed two inches of space between the vessels and the abscess, allowing safe drainage of the abscess.



Deep cervical abscess in a 50 year old woman

Additional Photographs



28 year old man with right renal colic pain; ultrasound showed grade 1 hydronephrosis



16 y/o woman G1P0 for ANC; dating ultrasound showed 2nd trimester pregnancy

Obstetric Ultrasound Registry to Date

Date	MA	G	P	GA	ANC?	Placenta?	Blood per vagina?	No fetal movement?	Pre Ultrasound Diagnosis	Post Ultrasound Diagnosis
8/14/2008	19	1	0	0	Yes	No	No	No	Pregnancy	2nd trimester pregnancy
8/18/2008	20	3	2	0	Yes	No	No	No	Pregnancy	2nd trimester pregnancy
8/19/2008	31	7	6	21	Yes	No	No	No	pregnancy	2nd trimester pregnancy
8/20/2008	30	4	2	40	Yes	No	No	No	Term pregnancy	(same)
8/20/2008	28	5	3	0	Yes	No	No	No	Pregnancy	2nd trimester pregnancy
8/25/2008	16	1	0	27	Yes	No	No	No	2nd trimester pregnancy	2nd trimester pregnancy
8/25/2008	25	3	2	20	Yes	No	No	No	2nd trimester pregnancy	grade 1 placenta previa
8/25/2008	36	8	7	0	Yes	No	No	No	Likely pregnancy	3rd trimester pregnancy
8/27/2008	26	4	3	17	Yes	No	No	No	2nd trimester pregnancy	(same)
8/27/2008	20	1	0	19	Yes	No	No	No	2nd trimester pregnancy	(same)
8/27/2008	22	1	0	12	Yes	No	No	No	1st trimester pregnancy	(same)
9/8/2008	28	6	4	0	Yes	No	No	No	pregnancy	2nd trimester pregnancy
9/8/2008	22	2	1	41	Yes	No	No	No	term pregnancy	(same)
9/9/2008	26	4	3	0	No	No	No	Yes	missed abortion	(same)
9/15/2008	20	2	1	31	Yes	No	No	No	3rd trimester pregnancy	(same)
9/15/2008	16	1	0	32	Yes	Yes	No	No	3rd trimester pregnancy	(same)
9/17/2008	22	3	2	0	Yes	No	No	No	amenorrhea, upt positive	1st trimester pregnancy
9/17/2008	29	4	2	38	Yes	Yes	No	No	third trimester pregnancy	third trimester pregnancy
9/18/2008	23	4	3	27	No	Yes	No	No	antepartum hemorrhage	anterior placenta previa
9/19/2008	30	4	3	0	No	No	Yes	Yes	incomplete abortion	completed abortion
9/22/2008	20	3	1	34	Yes	No	Yes	No	pregnant; vaginal bleeding	missed abotion
9/24/2008	21	1	0	32	Yes	Yes	No	No	3rd trimester pregnancy	(same)
9/24/2008	22	3	2	43	Yes	Yes	No	No	post-term pregnancy	(same)
9/25/2008	28	4	3	8	No	No	Yes	No	abortion	completed abortion
9/25/2008	30	3	2	12	No	No	Yes	No	pregnant vaginal bleeding	incomplete abortion

Note: MA=maternal age; G=gravida; P=para; GA=gestational age; ANC?= was ultrasound for antenatal care?; Placenta?=was for evaluation of placenta?

Non-obstetric Ultrasound Registry to Date

Date	Gender	Age	Primary Exam	Probe	Primary Reasons for Exam	Primary Findings	Pre Ultrasound Dx	Post Ultrasound Dx	Intervention
8/15/2008	female	56	RUQ	3S	R flank pain	nl kidneys, nl GB	Renal colic	(same)	symptomatic treatment
8/18/2008	male	6	Skin/Soft Tissue	3S	Proximal lower extremity swelling	Deep abscess	Deep abscess	(same)	I+D
8/19/2008	female	30	RUQ	3S	Chronic epigastric pain	nl GB, nl kidneys	Abdominal pain, NOS	(same)	symptomatic treatment
8/19/2008	female	52	RUQ	3S	Chronic epigastric pain	nl GB, nl kidneys	Abdominal pain, NOS	(same)	symptomatic treatment
8/19/2008	female	35	RUQ	3S	chronic RUQ pain	cholelithiasis	Abdominal pain, NOS	cholelithiasis	symptomatic treatment + referral
8/20/2008	female	60	RUQ	3S	chronic epigastric pain	nl GB, nl kidneys	Abdominal pain, NOS	(same)	symptomatic treatment
8/24/2008	female	42	Abdominal	3S	Abdominal pain, NOS	nl kidneys, nl gallbladder	Abdominal pain, NOS	(same)	Symptomatic tx
8/24/2008	male	6	Abdominal	3S	L abdominal mass	diffuse splenomegaly	L abdominal mass	Splenomegaly	Lab studies
8/25/2008	male	18	Abdominal	3S	L abdominal pain	nl GB, nl kidneys	Renal colic	Renal colic	Symptomatic treatment
8/25/2008	female	40	RUQ	3S	Chronic epigastric pain	nl GB, nl kidneys	Abdominal pain, NOS	(same)	Symptomatic treatment
8/25/2008	male	2	Abdominal	3S	Left renal colic	Grade 1 hydronephrosis	Left renal colic	Left hydronephrosis	Symptomatic treatment, referral
8/25/2008	female	20	RUQ	3S	R abdominal pain	nl GB, nl liver	R abdominal pain	(same)	symptomatic treatment
8/25/2008	female	27	Abdominal	3S	Renal colic	nl GB, nl kidneys	Renal colic	Renal colic	Symptomatic treatment
8/25/2008	male	25	Abdominal	3S	R renal colic	nephrolithiasis	R renal colic	R nephrolithiasis	Symptomatic treatment
8/27/2008	female	42	Vascular	12L	Abscess near great neck vessels and lower extremity	Two abscesses	Abscesses	(same)	I+D
8/29/2008	female	65	RUQ	3S	Chronic epigastric pain	no free fluid, nl kidney, nl GB	Abdominal pain, NOS	(same)	Symptomatic treatment
9/6/2008	female	10	Abdominal	3S	fall from height onto right lower chest / RUQ	no free fluid	possible intraperitoneal	intraperitoneal injury	diclofenac
9/7/2008	male	40	Renal	3S	right sided flank pain	nl kidney, no nephrolithiasis	renal colic	renal colic	NSAIDs, oral fluid
9/7/2008	male	34	Renal	3S	R sided flank / abdominal pain x 4 months	R hydronephrosis	right renal colic	R hydronephrosis	NSAIDs, fluids, referral
9/7/2008	male	36	Renal	3S	right sided flank /abdominal pain x 2 years	nl gallbladder, nl kidney	renal colic	renal colic	NSAIDs, oral fluid
9/8/2008	female	19	Abdominal	3S	RLQ pain x 2 days, check for free fluid	nl GB, nl kidney, nl liver, no free fluid	Abdominal pain, NOS	(same)	nsaids, serial abdominal exams
9/8/2008	female	40	Abdominal	3S	lower abdominal pain	large heterogenic mass in pelvis	Abdominal pain, NOS	pelvis mass	
9/8/2008	male	64	Renal	3S	chronic right flank pain	nl kidney, nl GB, nl liver	Abdominal pain, NOS	(same)	increase fluid intake
9/9/2008	female	28	RUQ	3S	right flank pain + vomiting x 3 days	grade 1 hydronephrosis	renal colic	hydronephrosis	NSAIDs, oral fluids, referral
9/9/2008	male	22		3S	L flank pain	normal kidneys	L renal colic	L renal colic	NSAIDs, oral fluid
9/14/2008	female	65	Renal	3S	L sided sharp flank pain x 1 week	L hydronephrosis	renal colic	hydronephrosis	referral, NSAIDs, fluids
9/14/2008	female	20	RUQ	3S	lower abdominal pain * 6 months	nl kidneys, nl GB, nl liver	Abdominal pain, NOS	(same)	reassurance
9/15/2008	female	35	Abdominal	3S	abdominal swelling x 5 months	ascites; nl kidneys, nl liver	abdominal swelling	diffuse ascites	
9/16/2008	male	89	RUQ	3S	ruq pain, vomiting x 2 days	nl gb, nl kidneys, nl liver	Abdominal pain, NOS	(same)	nsaids, fluids, ranitidine
9/18/2008	male	23	RUQ	3S	R abdominal pain x 1 month	mass	Abdominal pain, NOS	pelvic mass	referral
9/21/2008	female	27	RUQ	3S	epigastric pain x 1 month	nl gb, nl liver, nl kidney	Abdominal pain, NOS	same	nsaids, ppi, counseling
9/21/2008	female	60	RUQ	3S	burning micturation + heavy hematuria	nl kidneys	UTI	UTI	nsaids, abx, fluids
9/22/2008	female	24	Abdominal	3S	IUD placed 5 years prior, now missing thread	intrauterine device intact inside uterus	unclear location of IUD	IUD in uterus	referral for IUD removal
9/25/2008	female	7	Renal	3S	prior diagnosed ureteral stone, now with abd pain	nl kidneys	Abdominal pain, NOS	(same)	reassurance
9/29/2008	female	36	RUQ	3S	R sided abdominal pain + nausea x 4 days	nl GB, nl liver, nl right kidney	right renal colic	(same)	NSAIDs, oral fluid

Sanfe Bagar Medical Clinic Obstetric Ultrasound Logbook

IP:

Date ___/___/___ Time of exam ___:___ Gender: Male Female Age: ___

RIGHT UPPER QUADRANT ULTRASOUND Reason: Biliary colic

Other:_____ Results: Cholecystitis Cholelithiasis Normal Exam

Other:_____ Intervention: Hydration Other:_____

VASCULAR ULTRASOUND Vein(s) attempted: _____ Result: Vein accessed

IV Fluids Antibiotics Other: _____ No Vein accessed

RENAL ULTRASOUND Reason: Anuria UTIs Renal colic

Other:_____ Result: Hydronephrosis: Right Left Bilaterally None

Other:_____ Intervention: Hydration Other:_____

ABDOMINAL ULTRASOUND Reason: Acute abd Major trauma

Other:_____ Result: Free fluid in Morrison's Perisplenic Pelvic

Other:_____ Intervention: Hydration Other:_____

PULMONARY ULTRASOUND Reason: effusion? pneumothorax? Other:_____

Result: Effusion Pneumothorax Normal Exam Other:_____

Intervention: Chest tube Effusion drained Other:_____

CARDIAC ULTRASOUND Reason: effusion? cardiac dysfunction? Other:_____

Result: effusion Right heart strain SHD Contraction: Poor Mod Normal

Intervention: Pericardiocentesis Other:_____

SKIN/SOFT TISSUE ULTRASOUND Reason: Abscess Other:_____ Result:

Abscess No abscess Intervention: Incision and Drainage Other:_____

Summary

Probes: 4C 12L 3S EC8 Did ultrasound change management? Yes No

Pre-ultrasound dx: _____ Post-ultrasound dx: _____

Referral to: _____ Adequate study? Yes No If no, why? Machine malfunction Patient non-compliant Poorly visualized

IP:

Date ___/___/___ Time of exam ___:___

Reason: ANC: GA Placenta Fetus Blood per vagina No fetal movement

Maternal infection/symptoms Post-partum hemorrhage

Hx: G___P___ Maternal Age: ___ yrs Gestational Age: ___ weeks HCG: (+)(-)

ND

Results: Fetus: IUP Fetal products No IUP/FP Normal FHR abnormal FHR

Fetal movement: Yes No Fetal lie: Vertex Transverse Breech

Estimated Ultrasound Gestational Age: _____weeks obtained by measuring:

Gestational Sac BPD CRL OF diameter HC FL AG Humerus length

Placenta: Abruption Previa Normal

Pre-ultrasound dx: _____ Post-ultrasound dx: _____

Interventions: Induction D&C Antenatal Care Referral to: _____

Other: _____

IP:

Date ___/___/___ Time of exam ___:___

Reason: ANC: GA Placenta Fetus Blood per vagina No fetal movement

Maternal infection/symptoms Post-partum hemorrhage

Hx: G___P___ Maternal Age: ___ yrs Gestational Age: ___ weeks HCG: (+)(-)

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ND

Results: Fetus: IUP Fetal products No IUP/FP Normal FHR abnormal FHR

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Estimated Ultrasound Gestational Age: _____weeks obtained by measuring:

Gestational Sac BPD CRL OF diameter HC FL AG Humerus length

Placenta: Abruption Previa Normal

Pre-ultrasound dx: _____ Post-ultrasound dx: _____

Interventions: Induction D&C Antenatal Care Referral to: _____

Other: _____

Please record once per exam, even if multiple exams are done. So a patient with three exams (e.g., RUQ, vascular, cardiac) should have three entries

IP:

Date ___/___/___ Time ___:___ Gender: Male Female Age: ___
Exam: Right Upper Quadrant Renal Vascular Abdominal
 Pulmonary Cardiac Skin/Soft Tissue Other: _____
Reasons: _____

Findings: _____

Pre-ultrasound dx: _____ Post-ultrasound dx: _____

Interventions: _____

Referral to: Doti Dhangadi Nepalganj TEAM Other: _____
Probes: 4C 12L 3S EC8 Did ultrasound change management? Yes No
Adequate study? Yes No If no, why? Machine malfunction Patient non-compliant Poorly visualized Other: _____

IP:

Date ___/___/___ Time ___:___ Gender: Male Female Age: ___
Exam: Right Upper Quadrant Renal Vascular Abdominal
 Pulmonary Cardiac Skin/Soft Tissue Other: _____
Reasons: _____

Findings: _____

Pre-ultrasound dx: _____ Post-ultrasound dx: _____

Interventions: _____

Referral to: Doti Dhangadi Nepalganj TEAM Other: _____
Probes: 4C 12L 3S EC8 Did ultrasound change management? Yes No
Adequate study? Yes No If no, why? Machine malfunction Patient non-compliant Poorly visualized Other: _____

IP:

Date ___/___/___ Time ___:___ Gender: Male Female Age: ___
Exam: Right Upper Quadrant Renal Vascular Abdominal
 Pulmonary Cardiac Skin/Soft Tissue Other: _____
Reasons: _____

Findings: _____

Pre-ultrasound dx: _____ Post-ultrasound dx: _____

Interventions: _____

Referral to: Doti Dhangadi Nepalganj TEAM Other: _____
Probes: 4C 12L 3S EC8 Did ultrasound change management? Yes No
Adequate study? Yes No If no, why? Machine malfunction Patient non-compliant Poorly visualized Other: _____

IP:

Date ___/___/___ Time ___:___ Gender: Male Female Age: ___
Exam: Right Upper Quadrant Renal Vascular Abdominal
 Pulmonary Cardiac Skin/Soft Tissue Other: _____
Reasons: _____

Findings: _____

Pre-ultrasound dx: _____ Post-ultrasound dx: _____

Interventions: _____

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Date ___/___/___ Time ___:___ Gender: Male Female Age: ___
Exam: Right Upper Quadrant Renal Vascular Abdominal
 Pulmonary Cardiac Skin/Soft Tissue Other: _____
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Findings: _____

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Interventions: _____

Referral to: Doti Dhangadi Nepalganj TEAM Other: _____
Probes: 4C 12L 3S EC8 Did ultrasound change management? Yes No
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