DISPATCHES FROM THE GUILD CONFERENCE, SERIES #72

Uma Mahadevan, MD, Series Editor
guildconference.com

Computer-Aided Detection in Colonoscopy: Promise, Performance, and Real-World Questions


Tasnim Ahmed


Stephen Le Breton


Tyler M. Berzin

Computer aided polyp detection (CADe) is one of the most heavily studied applications of artificial intelligence in clinical medicine and may serve as a valuable adjunct for gastrointestinal endoscopists. Randomized controlled trials have demonstrated that CADe improves adenoma detection rates, particularly of smaller polyps and sessile serrated lesions. In this review, we provide an overview of the potential benefits and harms associated with CADe, as well as the limitations observed in real-world implementation. While modeling studies have demonstrated that CADe may be a cost-effective strategy to improve colonoscopy quality, it remains to be seen whether it will have a meaningful impact on colon cancer incidence rates, highlighting an important direction for future research.

INTRODUCTION

Colorectal cancer prevention through screening colonoscopy depends on one critical factor: the reliable detection and removal of precancerous polyps. Recent society guidelines increased the adenoma detection rate (ADR) performance goal from 25% to 35%, with differing thresholds by sex.[1] While numerous tools and techniques have been introduced over the years to enhance polyp detection, few have yielded performance gains as substantial as those seen with the advent of computer-aided polyp detection (CADe).[2] As missed lesions are a major driver of post-colonoscopy colorectal cancer (PCCRC), CADe may offer a meaningful opportunity to reduce this risk.[3] **(Fig 1a./1b.)**. Although more than 40 randomized trials have demonstrated the benefit of CADe in increasing polyp detection, real-world data have been more variable.[4] Important questions remain about the clinical benefit and cost-effectiveness of CADe across varied clinical settings, and whether incremental gains in ADR can further reduce colon cancer risk, particularly

Tasnim Ahmed[1] Stephen Le Breton[1] Tyler M. Berzin[2] [1]Department of Medicine, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston MA [2]Center for Advanced Endoscopy, Beth Israel Deaconess Medical Center, Harvard Medical School, MA

among endoscopists who already meet or exceed established quality benchmarks.[5]

The State of Evidence for CADe

The evidence demonstrating the benefit of CADe-assisted colonoscopies is generally very strong with numerous trials across North America, Europe, and China demonstrating that CADe improves polyp and adenoma detection rates, which are important surrogate markers for long term outcomes linked to preventing colorectal cancer incidence. Early clinical trials that compared standard colonoscopy to colonoscopies with computer-aided detection found a significant increase in ADR when artificial intelligence systems were used.[6] Wang et al.'s study, which was one of the first to investigate CADe, found that AI-assistance significantly increased ADR from 20% to 29%. Wallace et al. later investigated the impact of AI on adenoma miss rates, or the number of lesions that were missed by an initial colonoscopy, calculated as a ratio of adenomas detected in a second colonoscopy to the cumulative detected between the first and second. This study found that AI detection tools reduced the miss rate of neoplasia two-fold, improving the efficacy of screening colonoscopies.[7]

Much of the documented benefit of CADe technology seems to be driven by improving detection of smaller polyps. Hassan et al. conducted a meta-analysis of 21 randomized control trials investigating CADe and found that overall, CADe did not increase the number of advanced adenomas identified per patient, but did increase the number of diminutive adenomas, or adenomas that are less than 5mm, identified per colonoscopy.[8] Another meta-analysis involving 25 trials found that CADe was associated with higher sessile serrated lesion detection rates (SSLDR).[9] These are the same lesions that are often missed and responsible for post-colonoscopy colorectal cancers, or cancers that are diagnosed after an initial negative colonoscopy.[10] Considering the updated quality benchmarks for colonoscopy in 2024 now call for SSLDR as a new priority quality indicator, emerging data regarding the ability of CADe to improve sessile lesions is particularly important.[1]

Variable Impact of AI

The effects of CADe on polyp detection also seem to vary in different clinical settings and in the hands of different endoscopists. For instance, in several community-based and observational trials, CADe benefit has been more variable.[11] In fact, one study even showed that CADe seemed to have a negative effect, leading to lower ADR after it was introduced in a large volume center to assess its real-world capabilities.[12] There are a variety of potential explanations for this, ranging from variability in baseline adenoma detection rates, endoscopist engagement with the technology, to subtle differences in clinical practice environments—all of which may influence real-world effectiveness

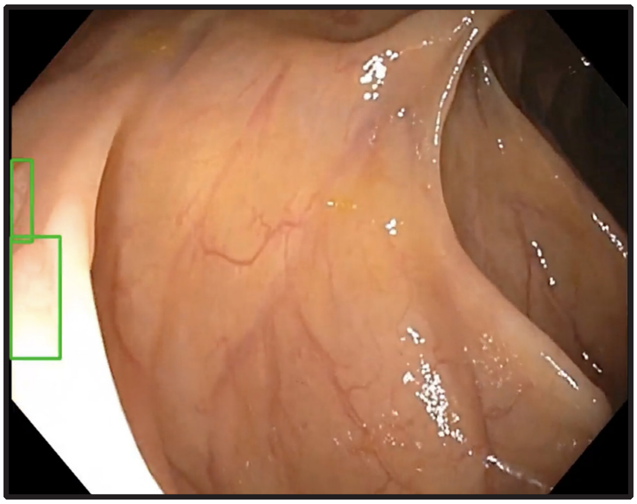

Figure 1a. Computer aided polyp detection (CADe) of polyp at very edge of screen

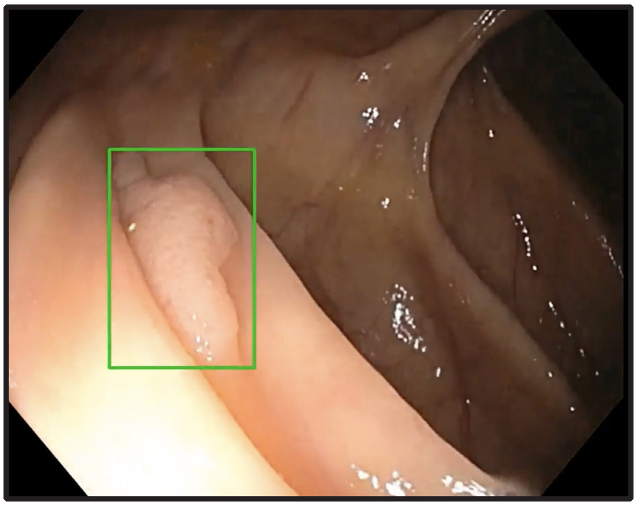

Figure 1b. Same polyp, subsequently centered by endoscopist prior to resection

of technology adoption. These findings underscore that while CADe offers promise, its performance is not immune to clinical context and operator factors.

Another factor that may influence the benefit of CADe is the expertise and baseline performance level of the endoscopist performing the procedure. Studies conducted in settings with lower average ADRs have shown that CADe can significantly enhance detection, helping to close quality gaps.[8] Among those with already high ADR, the added benefit of CADe appears more limited, suggesting a ceiling effect where the opportunity for further improvement is inherently constrained. Moreover, even if CADe does provide an ADR benefit for physicians with high baseline ADR, it is questionable whether these incremental performance gains translate to real clinical benefit for patients by reducing interval colon cancer risk.[5]

The observation that AI appears to disproportionately benefit less experienced endoscopists has also sparked ongoing debate around its impact on innate skill.[13] A retrospective study from Poland evaluated adenoma detection rates in endoscopists three months before and after implementation of CADe in their endoscopy suites. Interestingly, the study found a small decline in ADR when endoscopists returned to conventional colonoscopy, raising concerns that prolonged reliance on CADe might degrade natural detection ability, otherwise known as "de-skilling".[14] However, on closer analysis, it seems unlikely that this represents true erosion of skill as it's difficult to imagine that well-established pattern recognition and polyp detection instincts would disappear after only a few months of AI use. More plausibly, this reflects a natural cognitive adaptation, a shift in attention or off-loading of certain detection tasks to the AI. As with pilots using autopilot, some redistribution of cognitive effort is expected when humans operate alongside assistive technologies. This attentional rebalancing may reduce vigilance in the short term but does not necessarily imply permanent loss of ability.

Moreover, this type of cognitive adaptation is neither surprising nor unique to medicine. It mirrors what we observe across many domains of life with the steady march of technology. Just as drivers recalibrate their spatial awareness when using GPS, or pilots adjust attentional focus when flying with autopilot, endoscopists working alongside CADe to naturally redistribute cognitive effort. These shifts don't necessarily signal loss of skill but rather an evolution in how expertise is applied when augmented by technology. Nonetheless, it will be critical to design clinical training and workflow models that preserve core clinical capabilities while leveraging the advantages of AI.

It's certainly possible that with diligence, AI can be safely incorporated into screening colonoscopy, without decreasing endoscopists' skill level, as many individual endoscopist had demonstrated in this study. However, what is less certain is the impact that AI may have on trainees who have yet to build a foundational skillset. "Never-skilling" is the concept that a novice or trainee never manages to develop the core competencies for endoscopy because they are likely to rely heavily on computer vision to identify abnormal polyps versus their own intuition. It is undeniable that CADe improves the quality of trainees' colonoscopies by significantly increasing ADR and SSLDR and helps to meet benchmarks delineated by the American College of Gastroenterology.[15] Combatting "never-skilling" may look like implementing accreditation requirements that trainees complete some number of colonoscopies without AI-assistance to become competent on their own.

Slow Adoption from Societies

There continues to be hesitancy in the large-scale adoption of CADe. Early last year, the British Medical Journal released a living practice guideline that recommended against the routine use of CADe in adults undergoing a colonoscopy.[16] Much of this is due to inconclusive and variable data on whether CADe significantly improves adenoma detection rate to lead to an actual reduction in colon cancer prevalence. Given the relative infancy of artificial intelligence tools, there are no longitudinal studies yet to assess the long-term impact of CADe on reducing colorectal cancer rates. A microsimulation study was conducted to model the impact of CADe on 10-year colorectal cancer incidence and mortality rates amongst patients aged 60 to 69. The study concluded that there would be no significant change in colorectal cancer incidence with CADe.[17] However, the study is unable to account for the constantly evolving

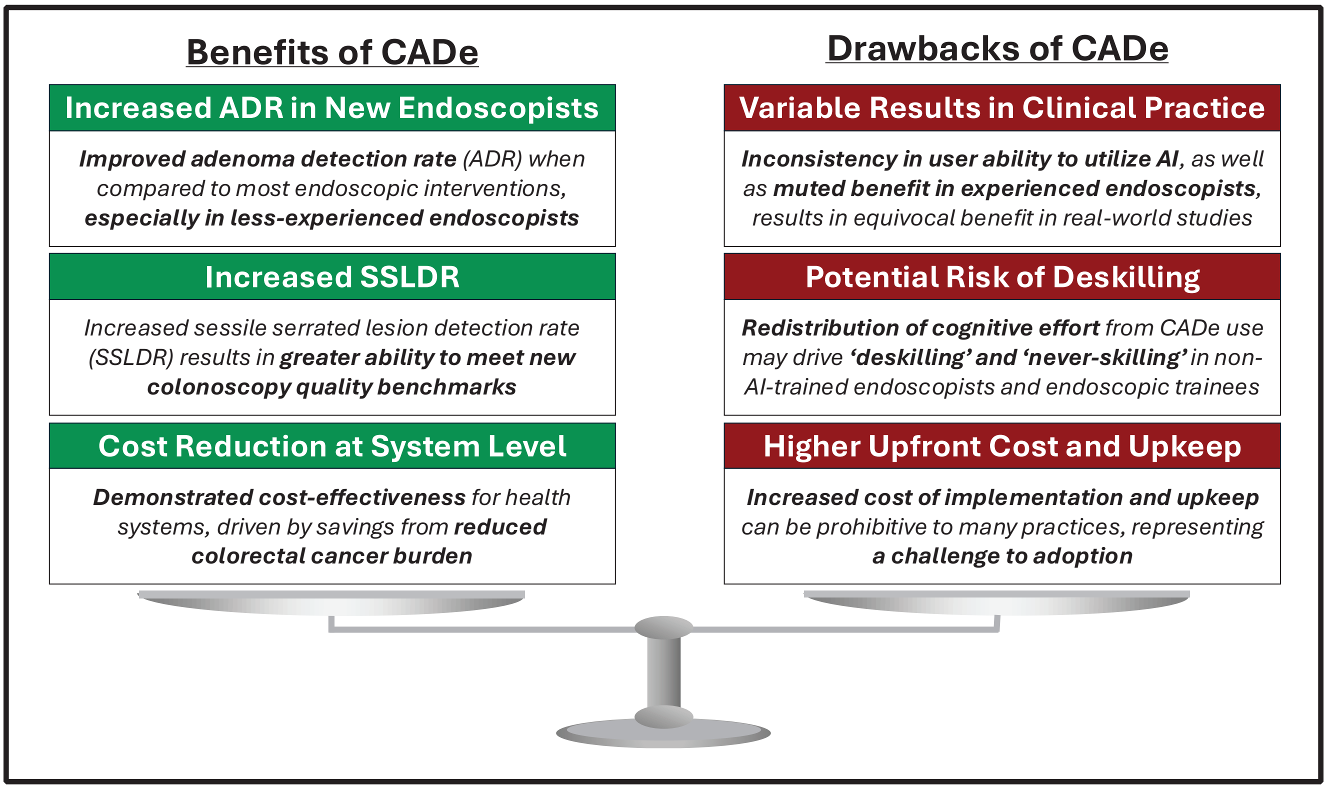

Figure 2. CADe demonstrates numerous benefits to implementation in daily practice, but also faces challenges that may limit utilization and uptake outside of academic centers.

nature of these artificial intelligence tools, which stands to improve in effectiveness over time.

Society guidelines also acknowledge the risks associated with widespread incorporation of CADe. The same modeling study found that while there were no significant differences in adverse events for either arm, CADe could lead to increased unnecessary surveillance after screening colonoscopies and a higher burden on the health care system.[17] CADe may also lead to unnecessary resections, mostly of small hyperplastic polyps. Altogether, these additional interventions would culminate in additional and unnecessary healthcare spending and brings to question the cost-effectiveness of this tool.

Cost Effectiveness of CADe

Currently, there are only a few CADe devices that have FDA approval, and their widespread implementation would come with an initial upfront cost. However, over time, the hope is that money saved from avoiding costly colorectal cancer treatment would offset this investment. One group of researchers modeled the economic implications of artificial intelligence on screening colonoscopies for the US health care system. They estimated that the costs of AI systems would be $19 per procedure based on the prices of available AI tools at the time of the study.[18] The marginal benefit of AI colonoscopy on colorectal cancer incidence and mortality had a significant impact on overall cost to the health care system. The model showed that screening colonoscopies with AI would reduce the cost of a colonoscopy by $57 per individual when assuming just a 60% screening uptake, even when accounting for additional surveillance colonoscopies and polypectomies with pathology. Yearly, this would amount to $290 million of savings for the country.[18] So, while AI-assisted colonoscopies may lead to more surveillance, in the long term it may still be cost effective on a population level.

Beyond CADe: CADx, CAQ and More

Following computer aided detection, the natural next step in implementing artificial intelligence to streamline colorectal cancer screening would be to use AI to aid in polyp diagnosis. Computer-aided diagnosis (CADx) enables endoscopists the ability to visually distinguish between non-neoplastic and neoplastic polyps without pathological review. Currently, many endoscopists conservatively elect to resect all polyps, given the difficulty in discriminating between polyps that will develop into cancer and those that will not, resulting in unnecessary resections of non-neoplastic polyps.

CADx tools assist optical diagnosis by providing a real-time prediction to the endoscopist, regarding whether a polyp is adenomatous or hyperplastic. For ruling out neoplastic lesions (precancerous polyps), CADx algorithms demonstrated a high negative predictive value of greater than 90% in an early study.[19] However, across numerous clinical trials, it remains unclear whether CADx can meaningfully impact clinical practice for instance by supporting a ‘resect and discard’ strategy for small polyps.[20] Like CADe, studies that evaluated real-time use of CADx have demonstrated that its efficacy may vary by endoscopist experience and polyp morphology.[21] Looking ahead, as the technology continues to advance and improve, CADx might also be a promising technology to explore in low-resourced settings, where pathologists and labs are scarce.

Recently, the FDA has also approved a computer-aided quality assessment (CAQ) tool that can serve to measure colonoscopy quality by incorporating factors such as bowel preparation, withdrawal time, and cecal intubation. Pilot studies show promise that the technology is making progress towards measuring certain colonoscopy quality indicators (e.g., cecal landmarks and withdrawal time), although alignment between endoscopist bowel prep scoring and AI bowel prep scoring remains a challenge.[22]

CONCLUSION

AI-assisted colonoscopy is among the most extensively studied applications of artificial intelligence in clinical medicine, with growing evidence and rising enthusiasm pointing toward its inevitable integration into routine practice.[23] But gastroenterologists must be vigilant of how heavily they rely on these tools as an adjunct to their own clinical acumen. Different gastrointestinal societies have been hesitant to embrace these tools in their recommendations due to an uncertainty over the real-world effects on downstream colon cancer risk. Some of the heterogeneity in published outcomes may be explained by variability in endoscopists’ baseline expertise, technique, and adenoma detection performance. In general, endoscopists with less experience or lower baseline adenoma detection rates appear more likely to derive measurable benefit from AI assistance, but this also raises legitimate concerns about “deskilling” and “never skilling,” particularly in trainees. However, these AI tools appear to provide a tangible mechanism to improve the quality of colonoscopies and modeling studies hint that improvements in colonoscopy quality associated with AI assistance could ultimately yield downstream healthcare cost savings. AI assistance for adenoma detection is still in an early phase of the adoption curve, and as models continue to be trained, their efficacy too will likely improve. With a healthy degree of caution, implementing these tools can help gastroenterologists meet important benchmarks and improve clinical care. ■

References

1. Rex DK, Anderson JC, Butterly LF, et al. Quality Indicators for Colonoscopy. Official journal of the American College of Gastroenterology | ACG 2024;119(9):1754-80. doi: 10.14309/ajg.0000000000002972
2. Aziz M, Haghbin H, Sayeh W, et al. Comparison of Artificial Intelligence With Other Interventions to Improve Adenoma Detection Rate for Colonoscopy: A Network Meta-analysis. J Clin Gastroenterol 2024;58(2):143-55. doi: 10.1097/mcg.0000000000001813 [published Online First: 2022/11/29]
3. Pohl H, Robertson DJ. Colorectal Cancers Detected After Colonoscopy Frequently Result From Missed Lesions. Clinical Gastroenterology and Hepatology 2010;8(10):858-64. doi: 10.1016/j.cgh.2010.06.028
4. Patel HK, Mori Y, Hassan C, et al. Lack of Effectiveness of Computer Aided Detection for Colorectal Neoplasia: A

(continued on page 28)

(continued from page 26)

Systematic Review and Meta-Analysis of Nonrandomized Studies. Clinical Gastroenterology and Hepatology 2024;22(5):971-80.e15. doi: 10.1016/j.cgh.2023.11.029

5. Pilonis ND, Spychalski P, Kalager M, et al. Adenoma Detection Rates by Physicians and Subsequent Colorectal Cancer Risk. Jama 2025;333(5):400-07. doi: 10.1001/jama.2024.22975 [published Online First: 2024/12/16]
6. Wang P, Berzin TM, Glissen Brown JR, et al. Real-time automatic detection system increases colonoscopic polyp and adenoma detection rates: a prospective randomised controlled study. Gut 2019;68(10):1813-19. doi: 10.1136/gutjnl-2018-317500 [published Online First: 2019/03/01]
7. Wallace MB, Sharma P, Bhandari P, et al. Impact of Artificial Intelligence on Miss Rate of Colorectal Neoplasia. Gastroenterology 2022;163(1):295-304.e5. doi: https://doi.org/10.1053/j.gastro.2022.03.007
8. Hassan C, Spadaccini M, Mori Y, et al. Real-Time Computer-Aided Detection of Colorectal Neoplasia During Colonoscopy. Annals of Internal Medicine 2023;176(9):1209-20. doi: 10.7326/M22-3678
9. Ahmed T, Ali FS, Hicklen R, et al. S1246 Re-Examining Computer-Aided Polyp Detection in the Era of a New Quality Benchmark: A Meta-Analysis of ADR, PDR, and SSLDR. Official journal of the American College of Gastroenterology | ACG 2025;120(10S2):S269. doi: 10.14309/01.ajg.0001132444.28699.b5
10. Troelsen FS, Sørensen HT, Pedersen L, et al. Root-cause Analysis of 762 Danish Post-colonoscopy Colorectal Cancer Patients. Clin Gastroenterol Hepatol 2023;21(12):3160-69.e5. doi: 10.1016/j.cgh.2023.03.034 [published Online First: 2023/04/10]
11. Wei MT, Shankar U, Parvin R, et al. Evaluation of Computer-Aided Detection During Colonoscopy in the Community (AI-SEE): A Multicenter Randomized Clinical Trial. Official journal of the American College of Gastroenterology | ACG 2023;118(10)
12. Levy I, Bruckmayer L, Klang E, et al. Artificial Intelligence-Aided Colonoscopy Does Not Increase Adenoma Detection Rate in Routine Clinical Practice. Am J Gastroenterol 2022;117(11):1871-73. doi: 10.14309/ajg.0000000000001970 [published Online First: 2022/08/25]
13. Lou S, Du F, Song W, et al. Artificial intelligence for colorectal neoplasia detection during colonoscopy: a systematic review and meta-analysis of randomized clinical trials. eClinicalMedicine 2023;66 doi: 10.1016/j.eclinm.2023.102341
14. Budzyń K, Romańczyk M, Kitala D, et al. Endoscopist deskilling risk after exposure to artificial intelligence in colonoscopy: a multicentre, observational study. The Lancet Gastroenterology & Hepatology 2025;10(10):896-903. doi: 10.1016/S2468-1253(25)00133-5
15. Orzeszko Z, Gach T, Necka S, et al. The implementation of computer-aided detection in an initial endoscopy training improves the quality measures of trainees' future colonoscopies: a retrospective cohort study. Surg Endosc 2025;39(8):5276-86. doi: 10.1007/s00464-025-11890-3 [published Online First: 2025/07/01]
16. Foroutan F, Vandvik PO, Helsingen LM, et al. Computer aided detection and diagnosis of polyps in adult patients undergoing colonoscopy: a living clinical practice guideline. BMJ 2025;388:e082656. doi: 10.1136/bmj-2024-082656
17. Halvorsen N, Hassan C, Correale L, et al. Benefits, burden, and harms of computer aided polyp detection with artificial intelligence in colorectal cancer screening: microsimulation modelling study. BMJ Med 2025;4(1):e001446. doi: 10.1136/bmjmed-2025-001446 [published Online First: 2025/04/01]
18. Areia M, Mori Y, Correale L, et al. Cost-effectiveness of artificial intelligence for screening colonoscopy: a modelling study. The Lancet Digital Health 2022;4(6):e436-e44. doi: 10.1016/S2589-7500(22)00042-5
19. Kominami Y, Yoshida S, Tanaka S, et al. Computer-aided diagnosis of colorectal polyp histology by using a real-time image recognition system and narrow-band imaging magnifying colonoscopy. Gastrointestinal Endoscopy 2016;83(3):643-49. doi: https://doi.org/10.1016/j.gie.2015.08.004
20. Hassan C, Rizkala T, Mori Y, et al. Computer-aided diagnosis for the resect-and-discard strategy for colorectal polyps: a systematic review and meta-analysis. The Lancet Gastroenterology & Hepatology 2024;9(11):1010-19. doi: https://doi.org/10.1016/S2468-1253(24)00222-X
21. Bustamante-Balén M. Role of CADx in colonoscopy: lessons from real-life studies. Best Practice & Research Clinical Gastroenterology 2025:102020. doi: https://doi.org/10.1016/j.bpg.2025.102020
22. Brenner TA, Labaki C, Feuerstein JD, et al. Prospective Validation of the First US FDA-Approved Computer-Aided Quality Assessment Tool for Colonoscopy: An Initial Clinical Experience. The American journal of gastroenterology 2025 doi: 10.14309/ajg.0000000000003855
23. Han R, Acosta JN, Shakeri Z, et al. Randomised controlled trials evaluating artificial intelligence in clinical practice: a scoping review. Lancet Digit Health 2024;6(5):e367-e73. doi: 10.1016/s2589-7500(24)00047-5 [published Online First: 2024/04/27]

Answers to this month's crossword puzzle:

1 B	R	2 E	A	3 T	H	4 T	E	5 S	T		6 G	7 A	L	8 L
O		V		O		R		T		9 C	O	D		I
10 W	H	E	A	T		11 O	P	E	R	A	T	I	O	N
E		N				V		T		L		P		I
12 L	E	T		13 F	R	E	S	H		14 C	R	O	15 H	N
M				A				O		I		16 S	O	G
17 O	N	18 S	E	T		19 F	I	S	20 S	U	21 R	E	S	
V		T		22 T	E	A		23 C	O	M	E		T	
24 E	A	R	L	Y		25 S	T	O	O	L	T	26 E	S	27 T
M		I						P		A		X		I
28 E	29 N	C	Y	30 S	T	31 S		32 E	N	C	33 L	A	V	E
34 N	E	T		T		U				35 T	A	M		I
T		U		36 A	U	S	37 C	38 U	L	A	T	I	O	N
S		R		G		39 H	O	E		40 T	E	N		T
	41 H	E	R	E	D	I	T	Y		E		42 E	G	O