# MAJOR ARTICLE

# *Candida auris* Colonization After Discharge to a Community Setting: New York City, 2017–2019

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***Background.*** Patients colonized with multidrug-resistant *Candida auris* and discharged to a community setting can subsequently seek care in a different healthcare facility and might be a source of nosocomial transmission of *C auris*.

***Methods.*** We designed a case management pilot program for a cohort of New York City residents who had a history of positive *C auris* culture identified during clinical or screening activities in healthcare settings and discharged to a community setting during 2017–2019. Approximately every 3 months, case managers coordinated *C auris* colonization assessments, which included swabs of groin, axilla, and body sites yielding *C auris* previously. Patients eligible to become serially negative were those with ≥2 *C auris* colonization assessments after initial *C auris* identification. Clinical characteristics of serially negative and positive patients were compared.

***Results.*** The cohort included 75 patients. Overall, 45 patients were eligible to become serially negative and had 552 person-months of follow-up. Of these 45 patients, 28 patients were serially negative (62%; rate 5.1/100 person-months), 8 were serially positive, and 9 could not be classified as either. There were no clinical characteristics that were significantly different between serially negative and positive patients. The median time from initial *C auris* identification to being serially negative at assessments was 8.6 months (interquartile range, 5.7–10.8 months).

***Conclusions.*** A majority of patients, assessed at least twice after *C auris* identification, no longer had *C auris* detectable on serial colonization assessments.

***Keywords.*** *Candida auris*; colonization; community setting; New York City.

*Candida auris* is a globally emerging multidrug-resistant yeast that can spread in healthcare settings and cause invasive infections with high morbidity and mortality [1, 2]. During 2013–2019 in the United States, the Centers for Disease Control and Prevention (CDC) reported 1018 confirmed and probable clinical cases and 2051 screening cases identified during screening activities [3]. Approximately half of all clinical and screening cases in the United States have been identified in New York City (NYC) hospitals and nursing homes [4].

Persistent colonization with *C auris* has been a major challenge in the control of *C auris* transmission. In inpatient healthcare settings, especially nursing homes, most patients with *C auris* colonization remain colonized for extended periods [5], but it is unknown whether and how long patients remain colonized when discharged to a community setting. Patients colonized with *C auris* and discharged to a community setting could subsequently access healthcare again at the same or a different healthcare facility and might be a source of *C auris* transmission, if still colonized and infection control practices are not implemented. *Candida auris* infection control practices include hand hygiene, standard and contact precautions, and environmental cleaning with specialized disinfectants [6]. Of note, only a minority of patients (<15%) known to be colonized with *C auris* in New York State were discharged to a community setting, because most patients affected by *C auris* have multiple comorbidities and reside in nursing homes. The NYC Department of Health and Mental Hygiene (DOHMH) piloted a case management program for people colonized with *C auris* discharged to a community setting to monitor *C auris* colonization status over time to support and guide infection control practices.

## METHODS

### Case Ascertainment

Clinical cases were patients with positive *C auris* cultures, identified during testing done for the purpose of diagnosing or treating a disease. Screening cases were patients with positive *C auris* cultures but without clinical illnesses from *C auris*; they were identified during contact tracing, admission screening, or

point prevalence surveys at facilities affected by *C auris.* In the case management program, both clinical and screening cases were considered to be colonized with *C auris.*

New York State Department of Health (NYS DOH) requested notification from all healthcare facilities whenever a patient colonized with *C auris* was discharged or transferred. During October 2017–February 2019, NYS DOH referred to DOHMH all NYC residents colonized with *C auris* who were discharged from a hospital or nursing home to a community setting. The DOHMH's case management program included patients with a history of *C auris* positive cultures who were living in the community setting at the time of the NYS DOH referral.

### Case Investigation

Each person in the case management cohort was assigned to a DOHMH case manager who collected clinical information through patient or proxy interview and medical record review. At the time of the interview and record review, the case manager collected data on demographic characteristics, underlying conditions, medications, medical devices, functional status, current clinical providers, and location of prior medical care.

### *Candida auris* Colonization Assessments

Case managers attempted to coordinate *C auris* colonization assessments with the patient's outpatient providers approximately every 3 months. If the patient was readmitted to a healthcare facility, we partnered with NYS DOH to request that infection control practitioners at the facility collect samples. Assessments of colonization followed CDC guidance and, at a minimum, involved swabs of the axilla and groin and, when applicable and feasible, sites yielding *C auris* on previous cultures. Serial colonization reassessments were recommended by the CDC during the pilot [3]. Testing was performed at NYS DOH Wadsworth Center and included *C auris* real-time polymerase chain reaction (rt-PCR) [7], fungal culture, and isolate identification using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry. The NYS DOH laboratory methods are described elsewhere [8]. If *C auris* was not detected on any of the colonization tests, the colonization assessment was considered negative and was repeated at least 1 week later. If *C auris* was present on any of the tests, the colonization assessment was considered positive and was repeated approximately 3 months later.

### Outcome Classification

Patients eligible to become serially negative were patients with ≥2 colonization assessments after initial *C auris* identification. Confirmed serially negative patients had 2 consecutive negative *C auris* rt-PCR testing and fungal culture on all colonization assessment sites. Probable serially negative patients had ≥2 consecutive negative *C auris* rt-PCR testing of axilla and groin but lacked a corresponding fungal culture result or a site yielding *C auris* on previous cultures.

Serially positive patients had ≥2 *C auris* colonization assessments after initial *C auris* identification with ≥1 assessment ≥6 months after initial identification and the latest assessment positive. The 6-month requirement allowed identification of persistent colonization beyond the initial *C auris* identification period.

### Analysis

Clinical characteristics for patients serially negative and positive were compared by using Fisher's exact test and the Wilcoxon-Mann Whitney test for age. Incidence of having serially negative assessments was calculated by 6-month intervals and cumulatively over time. The follow-up period was from the initial *C auris* identification date to the last assessment date or death and measured in person-months. Patients eligible to become serially negative within each time interval were those with ≥1 *C auris* colonization assessment during the specified time interval and ≥1 other prior assessment after initial identification. All analyses were performed with data available as of July 28, 2019.

### Infection Control Support Activities

We spoke by telephone with the patient's outpatient providers and infection control programs in healthcare facilities used previously by the patient, recommending they use *C auris* infection control precautions for the patient and to flag the patient's electronic medical record as needing such precautions. Using emergency department (ED) and urgent care syndromic surveillance [9], we created a novel notification system to alert case managers when a patient in the *C auris* case management program might have presented for care at an ED or urgent care facility [10]. When case managers confirmed with healthcare personnel that a patient colonized with *C auris* had sought care at their facility, case managers informed or reminded the facility of the recommended infection control precautions.

### Patient Consent Statement

The DOHMH's Institutional Review Board and CDC reviewed this study for human subjects protection and determined it to be nonresearch. The study did not include factors necessitating patient consent.

## RESULTS

### Study Population

During October 2017–February 2019, NYS DOH referred 85 patients; 75 patients were included in the case management cohort (Figure 1). Of 45 patients eligible to become serially negative, 9 (20%) patients had assessments that could not be classified as either serially negative or positive, 8 (18%) patients were serially positive, and 28 (62%) patients were serially negative. Twenty-one 21 (28%) of 75 patients included in the case
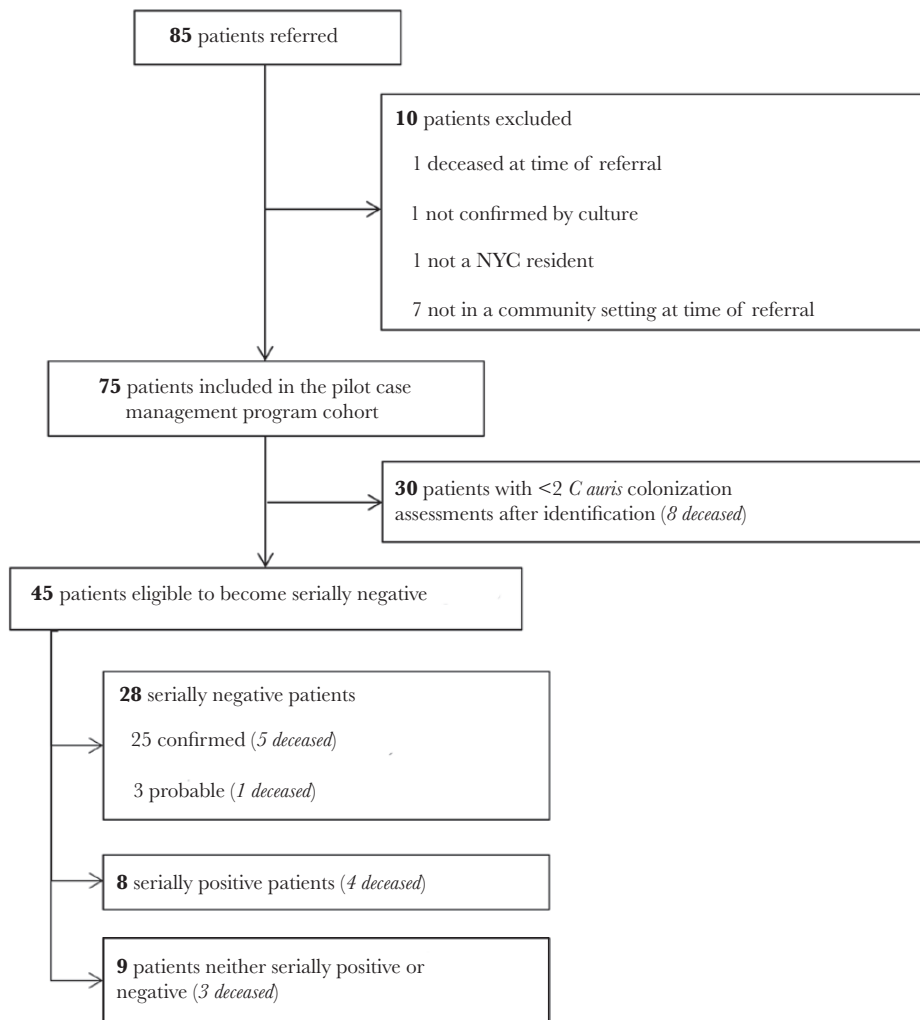
**Figure 1.** *Candida auris* case management population, New York City (NYC), 2017–2019. Patients eligible to become serially negative were patients with ≥2 colonization assessments after initial *C auris* identification. Confirmed serially negative patients had ≥2 consecutive negative *C auris* real-time polymerase chain reaction (rt-PCR) and fungal culture on all colonization assessment sites. Probable serially negative patients had ≥2 consecutive negative *C auris* rt-PCR testing of axilla and groin, but they lacked a corresponding fungal culture result or a site yielding *C auris* on previous cultures. Serially positive patients had ≥2 *C auris* colonization assessments after initial *C auris* identification with ≥1 assessment ≥6 months after initial identification and the latest assessment positive.

management cohort died after referral. According to case manager review, all 21 patients died of causes unrelated to *C auris* colonization.

**Patient Characteristics**

Among 36 patients either serially negative or positive, the median age was 63 years (interquartile range [IQR], 51–70.5 years), and 23 (64%) were male (Table 1). Twenty (56%) patients were screening cases, and 16 (44%) patients were clinical cases. A majority of patients had multiple comorbid medical conditions, 68% had reduced independence, and 64% had surgery in the 12 months before initial interviews. We found no clinical characteristics that were statistically different between patients who were serially negative or serially positive. It is notable that 63% (5 of 8) of serially positive patients had readmission to a

healthcare facility during the follow-up period, compared with 32% (9 of 28) of serially negative patients (*P* = .22). In addition, 63% (5 of 8) of serially positive patients were clinical cases, compared with 39% (11 of 28) of serially negative patients (*P* = .42).

***Candida auris* Colonization Over Time**

Assessment frequency and follow-up time varied by patient (Figure 2). The median time for patients to be reported as serially negative was 8.6 months (IQR, 5.7–10.8). For patients who became serially negative, the median time to the first negative *C auris* colonization assessment was 4.7 months (IQR, 3.5–7.5). Seven (25%) of 28 serially negative patients had repeat *C auris* colonization assessments ≥6 months after being reported as serially negative, and all had repeat negative assessments. In addition, 7 patients had a positive

**Table 1. Clinical Characteristics of 36 Patients Either Serially Negative or Serially Positive in the *Candida auris* Case Management Cohort, New York City, 2017–2019**

| Clinical Characteristics | No. (%) Persons in Total N = 36 | No. (%) Serially Negative N = 28 | No. (%) Serially Positive N = 8 | P Value[a] |
|---|---|---|---|---|
| Median age, years (interquartile range) | 63 (51–70.5) | 62 (49–70.5) | 64 (56–71.5) | .55 |
| Male | 23/36 (64%) | 18/28 (64%) | 5/8 (63%) | 1 |
| Surgery during 12 months before interview | 23/34 (68%) | 17/26 (65%) | 6/8 (75%) | 1 |
| Reduced independence[b] | 21/33 (64%) | 16/26 (62%) | 5/7 (71%) | 1 |
| Clinical *C auris* case (versus screening case) | 16/36 (44%) | 11/28 (39%) | 5/8 (63%) | .42 |
| Any indwelling drain, tubes, catheters, or lines during follow-up period | 16/35 (46%) | 12/27 (44%) | 4/8 (50%) | 1 |
| Diabetes | 15/36 (42%) | 11/28 (39%) | 4/8 (50%) | .69 |
| Readmission to a healthcare facility during follow-up period | 14/36 (39%) | 9/28 (32%) | 5/8 (63%) | .22 |
| Lung disease | 12/34 (35%) | 9/27 (33%) | 3/7 (43%) | .68 |
| Immunosuppression[c] | 7/36 (19%) | 6/28 (21%) | 1/8 (13%) | 1 |
| Renal failure requiring chronic dialysis | 7/36 (19%) | 6/28 (21%) | 1/8 (13%) | 1 |
| Any known exposure to systemic antibiotic or antifungals during follow-up period | 7/32 (22%) | 5/25 (20%) | 2/7 (29%) | 63 |
| Cancer, active | 6/36 (17%) | 4/28 (14%) | 2/8 (25%) | .60 |
| Any chronic wounds during follow-up period | 5/32 (16%) | 4/24 (17%) | 1/8 (13%) | 1 |
| Current smoker | 5/29 (17%) | 3/22 (14%) | 2/7 (29%) | .57 |

[a]P value for test of difference between serially negative and serially positive patients.

[b]Reduced independence was defined as having any of the following criteria: requiring assistance to perform hygiene tasks, being wheelchair bound, unable to leave a bed or have a condition that limits mobility or be unable to leave the house to go to medical appointments.

[c]Immunosuppression was defined as having any of the following: immunodeficiency, immunosuppression, currently undergoing radiation therapy, asplenia or splenectomy, organ transplant, human immunodeficiency virus with lower than normal CD4 count (<500 reported at time of initial interview), alcoholism, taking any steroid medication or immunosuppressive drug systemically during the follow-up period.

colonization assessment after having had a negative colonization assessment.

At 0–6 months after initial *C auris* identification, 8 (33%) of 24 eligible patients were reported as serially negative (2.6 patients/100 person-months) (Table 2). At 7–12 months, 15 (52%) of 29 eligible patients were reported as serially negative (10.6 patients/100 person-months), which represented the period with the highest observed rate of patients reported as serially negative. After following patients eligible to be serially negative for 552 person-months cumulatively, 28 (62%) of 45 patients were serially negative.

## DISCUSSION

In collaboration with NYS DOH, DOHMH piloted a case management program for people colonized with *C auris* who were discharged to a community setting. Although long-term colonization was observed among some people in a community setting, initial results suggest that on serial *C auris* colonization assessments, approximately two thirds of patients colonized with *C auris* and discharged to a community setting no longer have detectable *C auris* colonization. This finding might inform effort prioritization for *C auris* infection prevention and control because patients discharged to the community setting more frequently have serial negative assessments than patients who remain in healthcare facilities.

In contrast, of 45 eligible patients, 8 (18%) were serially positive and 9 (20%) could not be classified as either serially

negative or positive. Although the risk of transmission in the community from patients colonized with *C auris* is unknown, we attempted to reduce transmission risk in outpatient and hospital settings. We informed the patients' providers and previous hospitals of the patient's *C auris* status and provided education on appropriate infection control measures. In addition, we developed a notification system based on syndromic data to alert us when patients in the case management cohort likely presented for care in NYC EDs or urgent care facilities. Using the notification system, we identified 135 visits to health facilities for patients in the case management program from March 2018 to March 2019; in 18 (13%) of those visits, the health facility was unaware of the patient's *C auris* status and had not instituted appropriate infection control measures. Despite time-intensive efforts to support appropriate *C auris* infection control measures, patients discharged to the community who are colonized with *C auris* might present to healthcare settings with their *C auris* status unrecognized.

The CDC no longer recommends routine reassessments for *C auris* colonization, in part, because colonization assessments can alternate between *C auris* being detected and not detected, especially in the healthcare setting [11]. Among this cohort of patients discharged to a community setting, 7 patients had a positive colonization assessment after having had a negative colonization assessment, but no patients had *C auris* detected after having had 2 consecutively negative assessments. The meaning of an intermediate negative assessment in patients with a subsequent positive
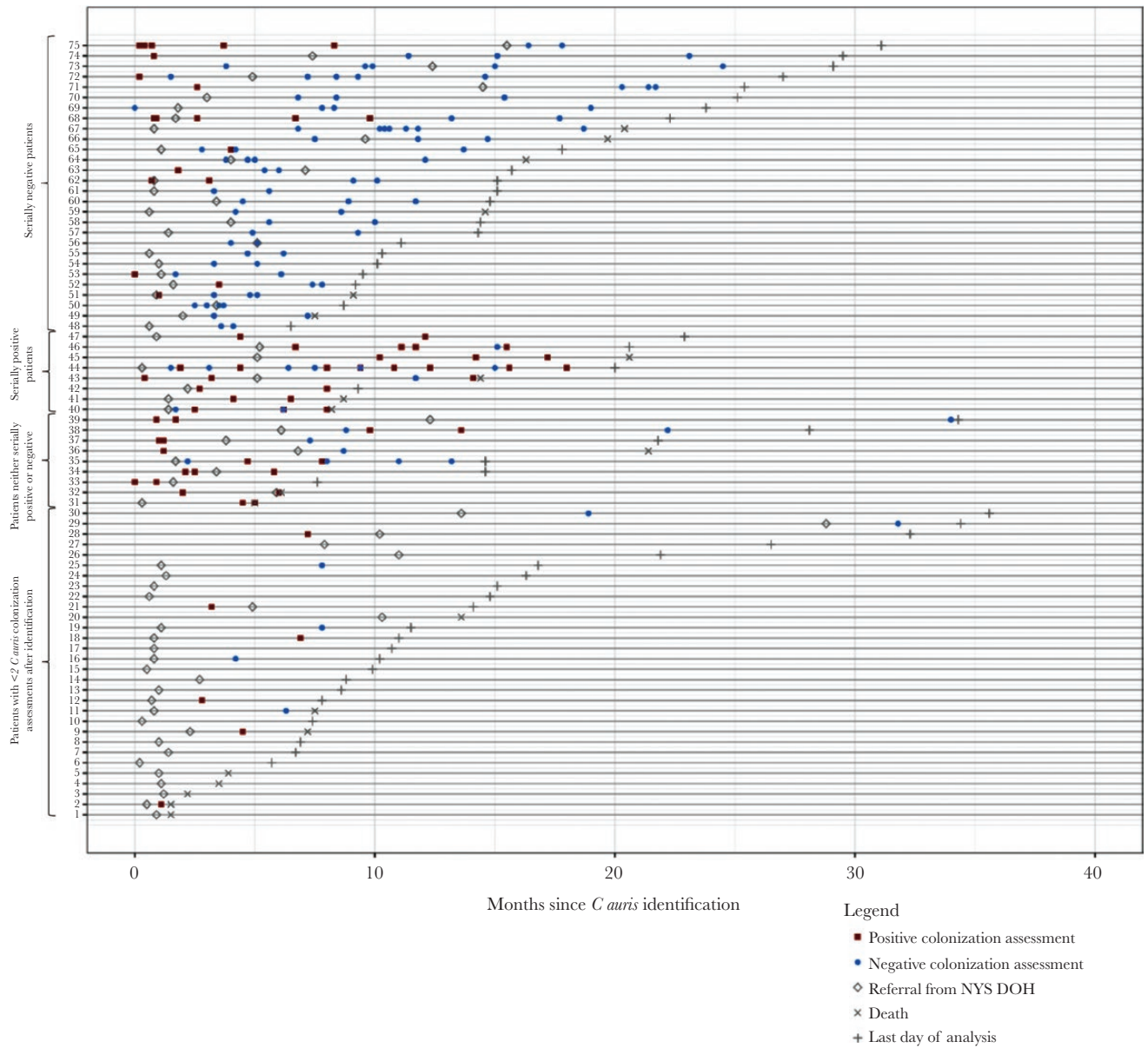
**Figure 2.** *Candida auris* assessments since initial *C auris* identification for patients in the case management cohort, New York City, 2017–2019. NYS DOH, New York State Department of Health.

**Table 2. Incidence of Patients with Serially Negative *Candida auris* Colonization Assessments Over Time, New York City, 2017–2019**

| Time Since Initial *C auris* Identification | Person-Months of Follow-up | Number of Patients Reported as Serially Negative | Number of Patients Eligible to Become Serially Negative | Proportion of Patients Reported as Serially Negative Among Eligible Patients | Rate of Patients Reported as Serially Negative (per 100 Person-Months) |
|---|---|---|---|---|---|
| Within Each Mutually Exclusive Time Interval | | | | | |
| 0–6 months | 312 | 8 | 24 | 33% | 2.6 |
| 7–12 months | 141 | 15 | 29 | 52% | 10.6 |
| 13–18 months | 62 | 4 | 10 | 40% | 6.5 |
| 19+ months | 37 | 1 | 3 | 33% | 2.7 |
| Cumulatively Over Time | | | | | |
| 0–19+ months | 552 | 28 | 45 | 62% | 5.1 |

assessment is uncertain and could represent colonization below the detection limit, variations in sampling methods, intermittent shedding, and recolonization after re-exposure. In recognition of those limitations, we used a conservative approach to categorize patients as serially negative that included testing multiple sites, at least 2 distinct negative assessments, and considering any positive test results as a positive assessment. Of note, the meaning of rt-PCR-positive but culture-negative samples is uncertain because it may represent nonviable organism. Among samples in this analysis where both rt-PCR and culture results were available at NYS DOH (593 of 747 samples, 79%), the positive predictive value of rt-PCR using culture as the gold standard was 91.4%.

The findings should be interpreted in the context of limitations. We only included patients for whom *C auris* was detected in a hospital or nursing home and NYS DOH was notified of a discharge to a community setting. The frequency of assessments was set at 3-month intervals but varied in practice, and the calculation of time to clearance was influenced by assessment frequency. The limited number of patients with either serially negative or positive assessments precluded more complex statistical analyses and identification of clinical factors associated with persistent colonization. Although findings were not statistically significant, clinical *C auris* cases and readmission to a healthcare facility after discharge might be more frequently associated with persistent colonization. Continued serial colonization assessments of patients in the outpatient *C auris* case management program might identify more patients who are serially negative and positive and associated clinical characteristics.

## CONCLUSIONS

Patients with persistent *C auris* colonization is a major challenge in the control of *C auris* transmission. In NYC, a minority of patients found to have positive *C auris* cultures were discharged to a community setting. Among these patients, the majority no longer had *C auris* detectable upon serial colonization assessments approximately 1 year after initial *C auris* identification.

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